

APPENDIX B

Water Injection Test Data by Arcadis G&M

Memorandum

To: Stephanie Sibbet (Boeing)
Brian Mossman (Boeing)
Scott Zachary (Haley & Aldrich)

CC: Frank Lenzo

From: Jim Nguyen/Jeffrey Friedman *JF*

Date: 10/24/02

Re: Hydraulic Test Results – Former C-6 Facility

ARCADIS G&M (ARCADIS) has prepared this technical memorandum to summarize the results of the hydraulic test performed at the former Boeing C-6 facility located in Los Angeles, California. The test was conducted in accordance with the Hydraulic Test Memorandum submitted to Boeing on June 26, 2002.

The test was conducted in the Middle Bellflower Aquitard that extends to a depth of approximately 115 feet below ground surface (bgs) that consists of the B-Sand, the Middle Bellflower Mud (BFM), and the C-Sand. The test was conducted in the upper and lower layer of the B-Sand; referenced as the Upper and Lower B-Sand. The Upper B-Sand is composed primarily of silty sand, with the upper and lower contacts situated at approximately 65 feet to 75 feet below ground surface (bgs) (13 to 23 feet below Mean Sea Level (MSL)). The Lower B-Sand is composed primarily of sand to gravelly sand with the upper and lower contact situated at approximately 75 feet to 90 feet bgs (23 to 38 feet below MSL). The hydraulic test was conducted inside the source area of Building 2, within the area identified to contain groundwater impacted by Trichloroethene (TCE) above 10,000 micrograms per liter ($\mu\text{g}/\text{L}$). Please refer to Figures 1 and 2 for the location of the hydraulic test.

Summarized below are the objectives, well installation activities, test procedures, and results.

Objectives

The purpose of the hydraulic test is to collect data to determine the following:

1. The hydraulic conductivity (K value) in the Upper and Lower B-Sand. The K value were evaluated using the slug test data;
2. The radius of influence for the amendment points in each zone (evaluated by injection of potable water with a bromide tracer);
3. The effectiveness of using a $\frac{3}{4}$ -inch diameter casing amendment point, installed using a cone penetrometer testing (CPT) rig. The effectiveness of using a $\frac{3}{4}$ -inch diameter casing amendment point, installed using a cone penetrometer testing (CPT) rig. The effectiveness is defined as how easily the amendment point can be installed, the integrity of the well, how well the solution is distributed to the targeted zones, and the duration of delivery; and

4. Dilution effects of groundwater on the amendment solution.

Well Installation and Development

One hydraulic test point (HT-0001), two down gradient monitoring points (HT-0003 and MW-0001), and one cross gradient monitoring point (HT-0002) were installed on June 25, 26, and 27, 2002 (Figure 2). Each location was completed with dual-nested points for a total of eight discreet well screen intervals. The points were screened between 65 and 75 feet below bgs (targeting the Upper B Sand and designated with an "A" suffix following the well number), and between 80 and 90 feet bgs (targeting the Lower B Sand and designated with an "B" suffix). Construction boring logs are included as Appendix A. In addition, CPT logging was conducted at HT-0001. The CPT log is included in Appendix B.

The hydraulic test points HT-0001 was completed with 0.75-inch diameter casings using a CPT rig. The downgradient and crossgradient points HT-0002 and HT-003 were completed using 1.5-inch diameter casings using a hollow-stem auger (HSA) drill rig. The monitoring point MW-0001 was completed using 2-inch diameter PVC casings using a HSA drill rig. Following well installation, monitoring points HT-0002, HT-0003, and MW-0001 were developed on July 1, 2002. Point HT-0001 was not developed due to the small diameter of the casing.

Slug Test Procedures and Results

After the wells were installed and developed, slug tests were conducted on July 11, 2002. Rising head slug tests were conducted using well MW-0001A (screened in the Upper B-Sand) and MW-0001B (screened in the Lower B-Sand). The rising head test was conducted by removing a slug from the well and recording the rate at which the water rises to static level. The rate at which water flows into the well and returns to the static level is used to estimate the hydraulic conductivity of the water-bearing zone.

To remove a slug of water from MW-0001A and MW-0001B, a PVC pipe (commonly referred to as a stinger) was lowered down to the groundwater. The stinger was connected to a hose that was connected to a vacuum truck. A vacuum was then applied to the hose to remove a slug of water from the well. The volume removed from wells MW-0001A and MW-0001B was approximately 5 and 15 gallons, respectively. A pressure transducer was placed approximately one foot above the bottom of the well to record the changes in the water level before a slug was removed and as groundwater rises to static level. The pressure transducers/data logger used for the test was In-Situ Troll (MiniTroll Pro, Model 8572). The data collected by the Troll were up-loaded into a laptop field computer. The test was considered complete once the groundwater level returned to the original static groundwater level. Data collected from the Trolls are included in Appendix C.

Due to the composition of the Lower B-Sand (sand and gravelly sand), instantaneous recharge was observed and, therefore, produced no significant drawdown in the well screen. Due to the quick recharge of the Lower B-Sand, no data could be collected to estimate the hydraulic conductivity. Conversely, due to the composition of the Upper B-Sand (silty sand), drawdown was observed in MW-0001A.

The data obtained from the Upper B-Sand was analyzed using hydraulic evaluation program called Aqtesolv (Copyright © HydroSOLVE, Inc.). The software permits time drawdown data to be evaluated using two commonly used slug test evaluation methodologies called the Bower-Rice and Hvorslev methods. The results of the analysis are summarized in the table provided on page 3. The hydraulic conductivity estimated from the Bouwer-Rice and Hvorslev methods yielded 3.87×10^{-7}

²centimeters/second (cm/sec) and 2.44×10^{-2} cm/sec, respectively. The estimated hydraulic conductivity is higher than expected for a silty sand zone. Based on Freeze and Cherry¹, the hydraulic conductivity for a silty sand zone should be approximately in the range of 1×10^{-3} to 1×10^{-5} . It is hypothesized that the difference between the slug test results and the published hydraulic conductivity were likely influenced by the sand pack situated around the well screen, thus, producing higher than expected K-values. Therefore, ARCADIS elected to rerun Aqtesolv using the data collected later in the test (i.e., the draw down data obtained after the break in slope, see chart in Appendix C). It is assumed that the early drawdown data is most likely representing recharge from the surrounding sand pack, and the later drawdown data is recharge from the formation. The calculated hydraulic conductivities based on the tail-end data set using the Bower-Rice and Hvorslev methods indicate K-values ranging from 3.67×10^{-3} to 5.77×10^{-3} cm/sec, which is more representative of a water bearing material, composed of silty sand. Using an averaged site hydraulic gradient of 0.0014 (Haley & Aldrich, Inc., 2002²) and a porosity of 0.31, the groundwater velocity was estimated to be between 17 and 27 feet per year using the Bouwer-Rice and Hvorslev methods, respectively. The slug test analysis using the Bouwer-Rice and Hvorslev methods are included in Appendices D through G.

Typical assumptions used in the Bouwer-Rice and Hvorslev methods are summarized below:

1. Homogeneous isotropic aquifer with infinite amount of water.
2. Exterior boundary of the aquifer is not encountered and therefore the aquifer is of infinite extent (Domenico & Schwartz, 1997).
3. The well has infinitesimal diameter compared with the aquifer.
4. The slab block is equivalent to the total depth of the well. Thus, the well completely penetrates the aquifer and, the aquifer depth is the same as the well depth.
5. Depth of saturated part of the aquifer is equivalent to the depth of water in the well.
6. The well is located in an unconfined aquifer.
7. Maximum possible iterations (999) were performed to lessen the standard errors in the result and obtain a best-fit curve.

Table 1: Estimated Hydraulic Conductivity (using well MW-0001A)

Analysis		Hydraulic conductivity (cm/sec)	Hydraulic gradient (ft/ft)	Porosity	Groundwater Velocity	
Method	Data Set				(ft/day)	(ft/yr)
Hvorslev	Complete	3.87×10^{-2}	0.0014	0.31	0.50	181
Bouwer-Rice	Complete	2.44×10^{-2}	0.0014	0.31	0.31	114
Hvorslev	Partial	5.77×10^{-3}	0.0014	0.31	0.07	27
Bouwer-Rice	Partial	3.67×10^{-3}	0.0014	0.31	0.05	17

¹ Freeze and Cherry, "Groundwater", 1979, Table 2-1.

² Annual Groundwater Monitoring Report, 2002, Haley & Aldrich, Inc

Injection Test Procedures and Results

The injection test was conducted on July 31, 2002. Testing was conducted in the Upper and Lower B-Sand using HT-0001A, HT-0001B, and MW-0001A. Potable water was added to each zone at varying pressures. Pressure transducers were installed in adjacent monitoring points to evaluate changes in groundwater elevation during injection activities.

The first test was conducted using HT-0001B as the injection point. A maximum pressure of 5 pounds per square inch (psi) was used to inject a total of 400 gallons over a duration of approximately 39 minutes. A flow rate of approximately 10 gallons per minute (gpm) was achieved during this test. A 0.4 to 1 foot change in groundwater elevation was noted in three adjacent monitoring wells (the furthest well is located approximately 15 feet from HT-0001B). A plot showing changes in groundwater elevations are included in Appendix H.

A second test was conducted using HT-0001A as the injection point. Potable water was initially injected at a pressure of 5 psi. A total of 3 gpm was achieved. The pressure was increased to 10 psi. Approximately 50 gallons was injected into the well before water was observed escaping around the well casing at land surface; migrating from the subsurface. It was suspected that the well might not have formed a proper seal during well construction; however, a change in groundwater elevation was noted in the nearby monitoring wells (0.4 ft maximum) during this injection event. Well HT-0001A was reinstalled on August 6, 2002.

Due to the results from the second test, a third test was conducted using well MW-0001A. Very little pressure (<1 psi) was required to inject 423 gallons of water over a duration of approximately 26 minutes. A flow rate of approximately 16 gpm was achieved during this test. Change in groundwater elevation was noted in the adjacent monitoring wells ranging from 0.8 to 1.6 feet (Appendix H). The table below summarizes the results of the injection tests.

Table 2: Results from Injection Test

Test No.	Injection Test Well	Formation	Soil Type	Well Screen (ft bgs)	Injection Pressure (psi)	Injection Flow Rate (gpm)	Change in Groundwater Elevation from Monitoring Wells (ft)
1	HT-0001B	Lower B-Sand	Sand to gravelly sand	80-90	5	10.3	0.4 to 1
2	HT-0001A	Upper B-Sand	Silty sand	65-75	10	3	0.4
3	MW-0001A	Upper B-Sand	Silty sand	65-75	<1	16	0.8 to 1.6

Bromide Tracer Test Procedures and Results

The bromide tracer test will be conducted once the Waste Discharge Requirement (WDR) permit is granted from the Los Angeles Regional Water Quality Control Board. Results from the bromide tracer test will be submitted under a separate cover.

Conclusion

Based on the results of the hydraulic test, the following conclusions can be made:

1. The estimated hydraulic conductivity for the Upper B-Sand is between 3.67×10^{-3} to 5.77×10^{-3} cm/sec. The estimated groundwater velocity using these values is between 17 and 27 feet per year. Due to the composition of the Lower B-Sand (sand and gravelly sand) a slug test was not successful at obtaining data to estimate the hydraulic conductivity.
2. A CPT rig was successful at installing the $\frac{3}{4}$ -inch diameter casing amendment point (HT-0001) to a depth of 90 feet bgs. The CPT rig was able to push a steel casing to 90 feet bgs in approximately 17 minutes. The $\frac{3}{4}$ -inch diameter well was used to inject water with a flow rate of approximately 10 gpm, and generated influence (via change in groundwater elevation) from monitoring wells located 15 feet from the injection well. However, careful backfilling of the well will be required to provide a proper seal.

Figures:

1-Hydraulic Test Location

2-Hydraulic Test Layout

Appendices:

A – Well Construction Log

B – Cone Penetrometer Test Data

C – Slug Test Data From Minitroll

D – Slug Test Analysis (Bouwer-Rice Method) for MW-0001A Using Complete Data Set

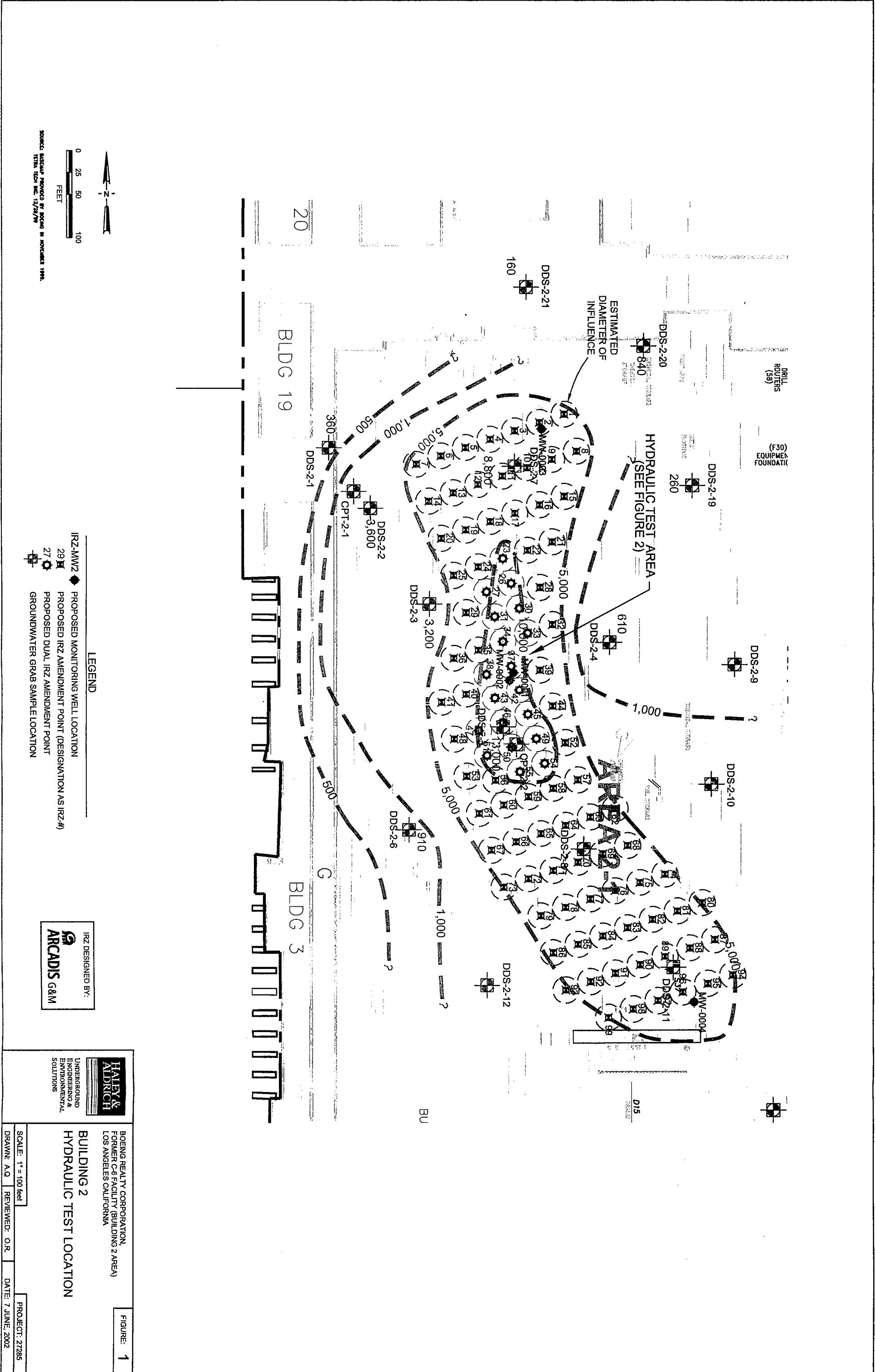
E – Slug Test Analysis (Hvorslev Method) for MW-0001A Using Complete Data Set

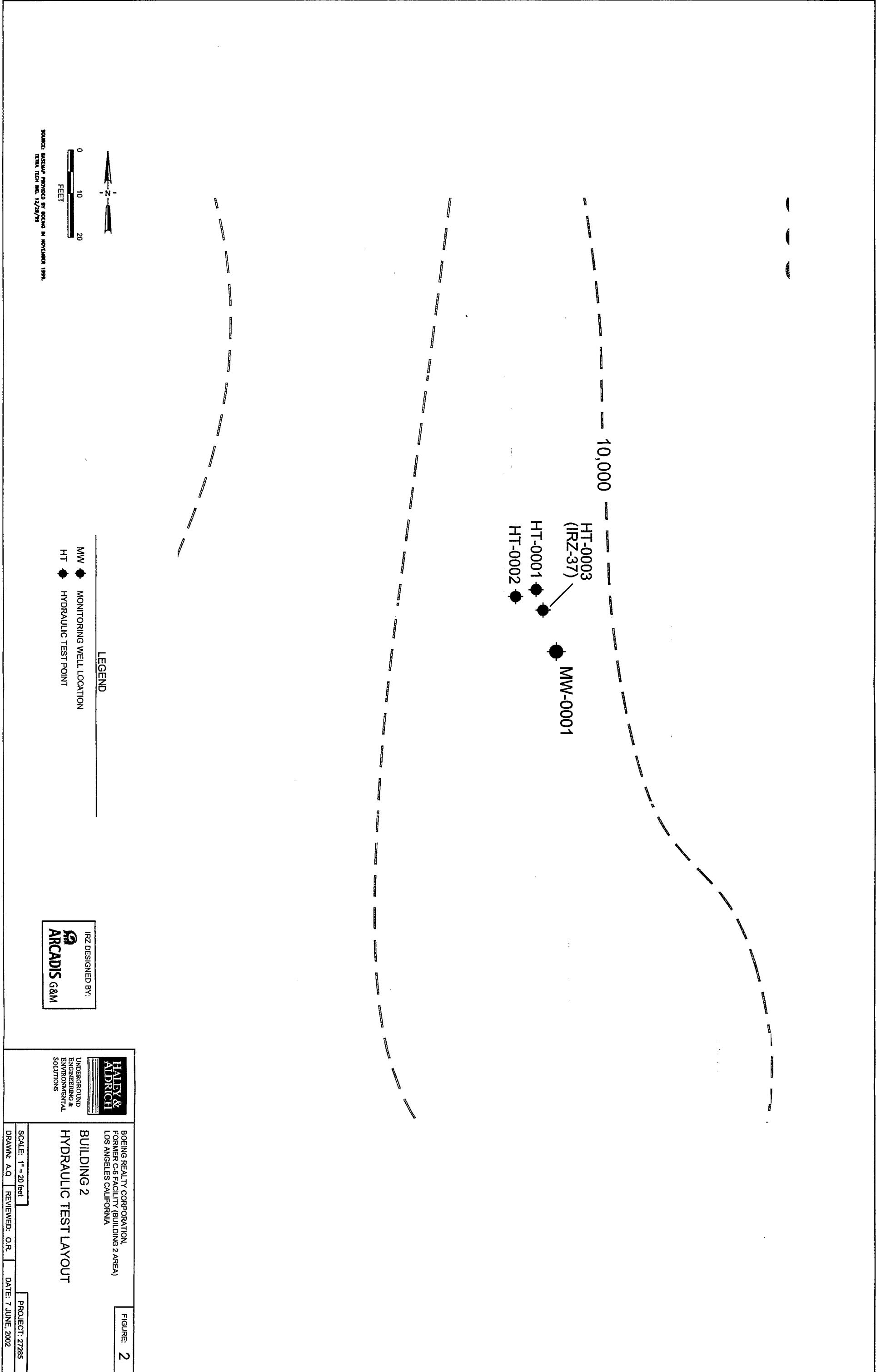
F – Slug Test Analysis (Bouwer-Rice Method) for MW-0001A Using Partial Data Set

G – Slug Test Analysis (Hvorslev Method) for MW-0001A Using Partial Data Set

H – Change in Groundwater Elevation During Injection Activities

Figures





Appendix A

Well Construction Log



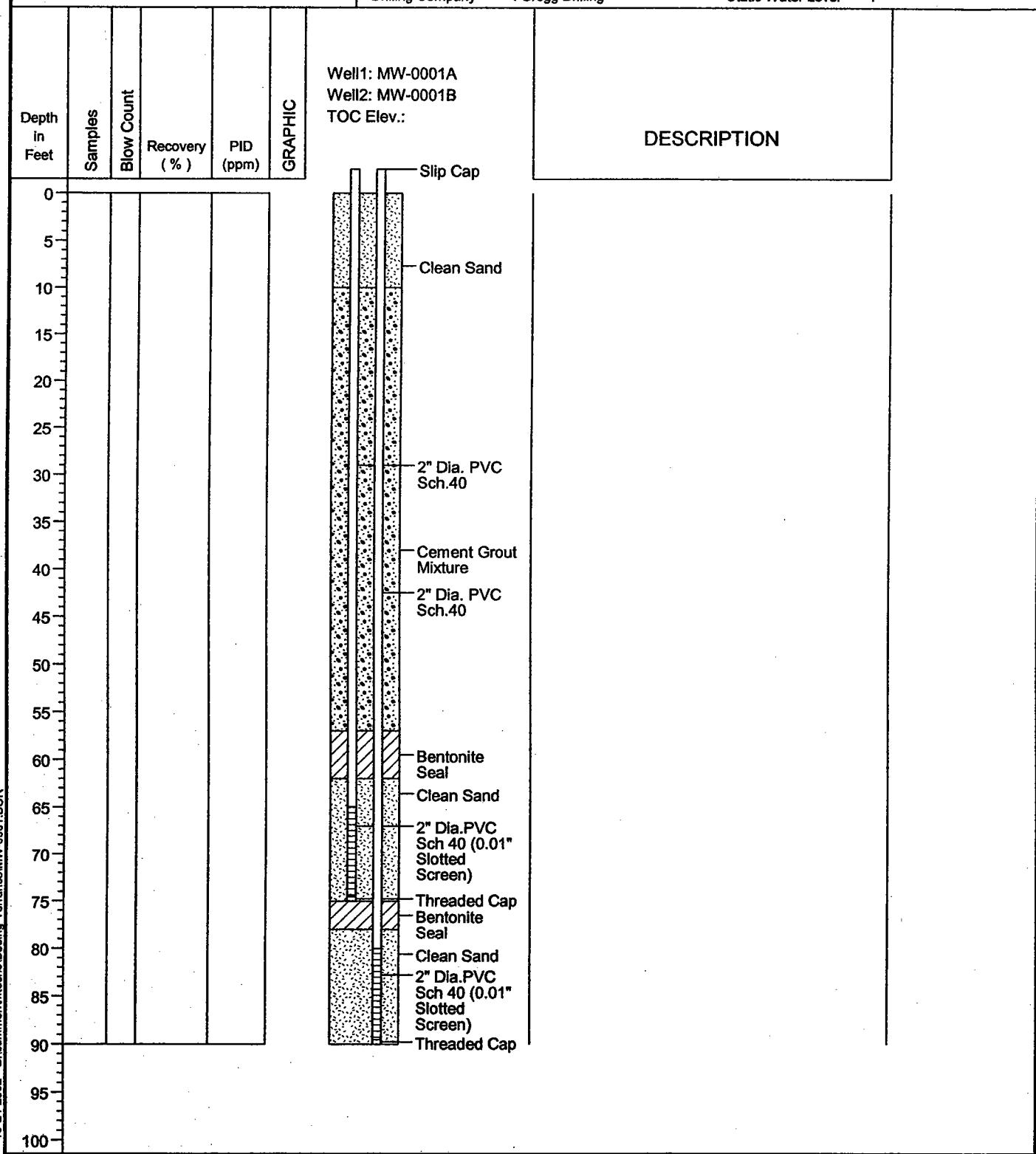
BORING LOG OF MW-0001

(Page 1 of 1)

Boeing - Torrance

CA000549.0001.00002

Date Started : June 26, 2002 Sampling Device : –
Date Completed : June 27, 2002 Drill Rig : MARL 12
Logged By : – Drillers : Tom, Sabino
Checked By : Olivia Edwards Diameter : 10 inches
Drilling Company : Gregg Drilling Static Water Level :





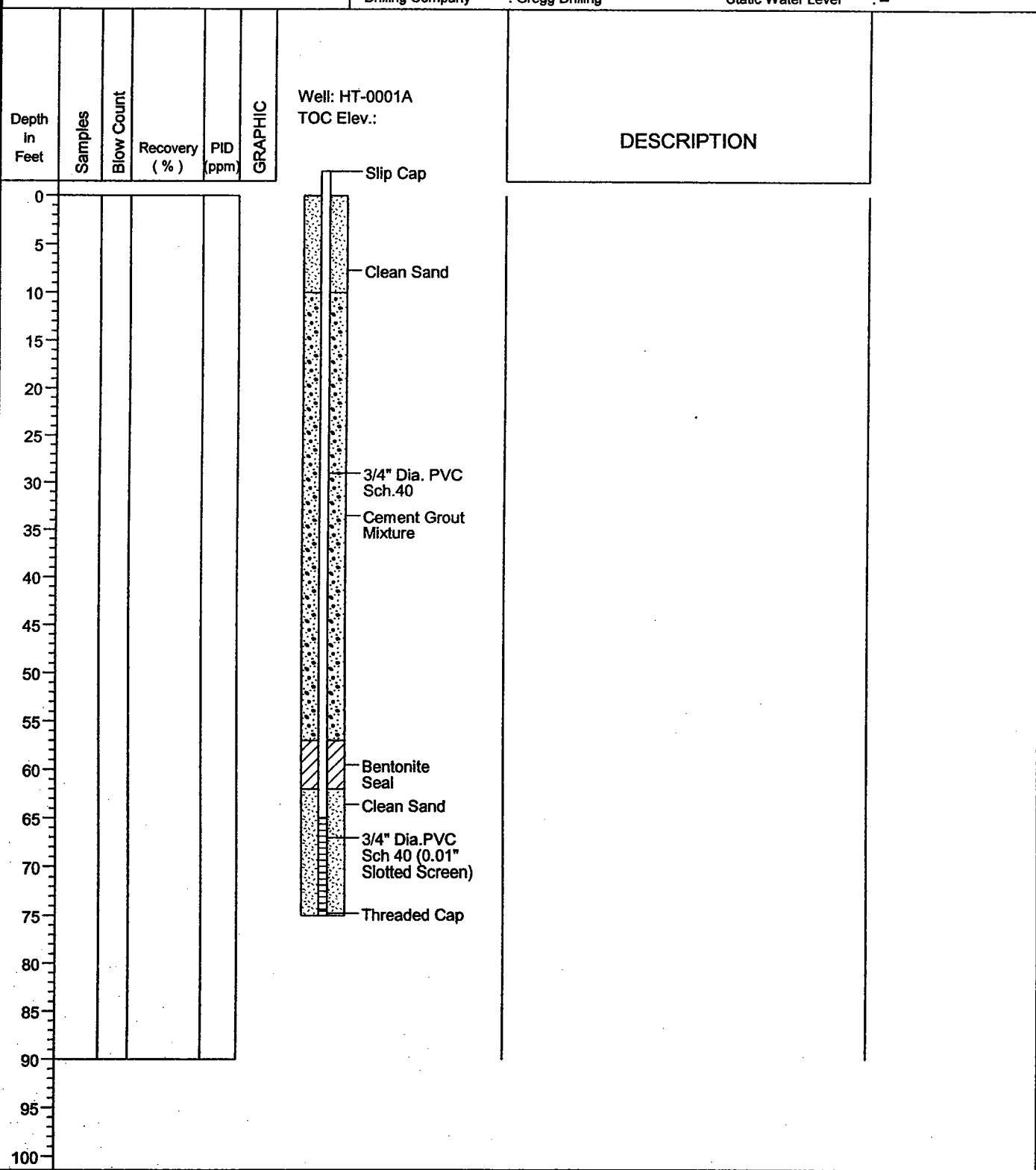
BORING LOG OF HT-0001A

(Page 1 of 1)

Boeing - Torrance

CA000549.0001.00002

Date Started : August 6, 2002 Sampling Device : -
Date Completed : August 6, 2002 Drill Rig : CPT
Logged By : - Drillers : Roger, Jeff
Checked By : Olivia Edwards Diameter : 2 1/4"
Drilling Company : Gregg Drilling Static Water Level : -





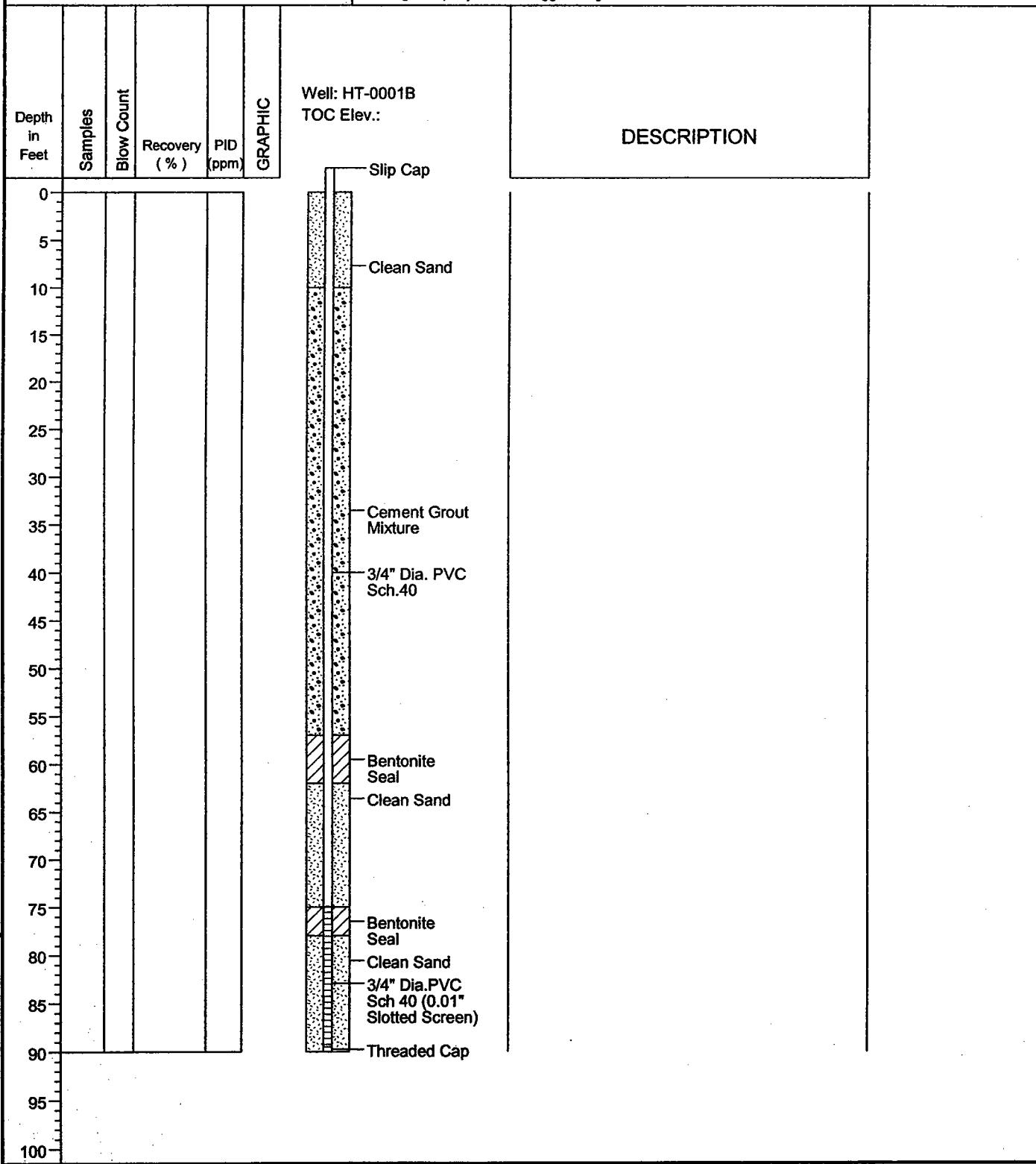
BORING LOG OF HT-0001B

(Page 1 of 1)

Boeing - Torrance

CA000549.0001.00002

Date Started : June 26, 2002 Sampling Device : –
Date Completed : June 26, 2002 Drill Rig : CPT
Logged By : – Drillers : Roger, Jeff
Checked By : Olivia Edwards Diameter : 2 1/4"
Drilling Company : Gregg Drilling Static Water Level : –





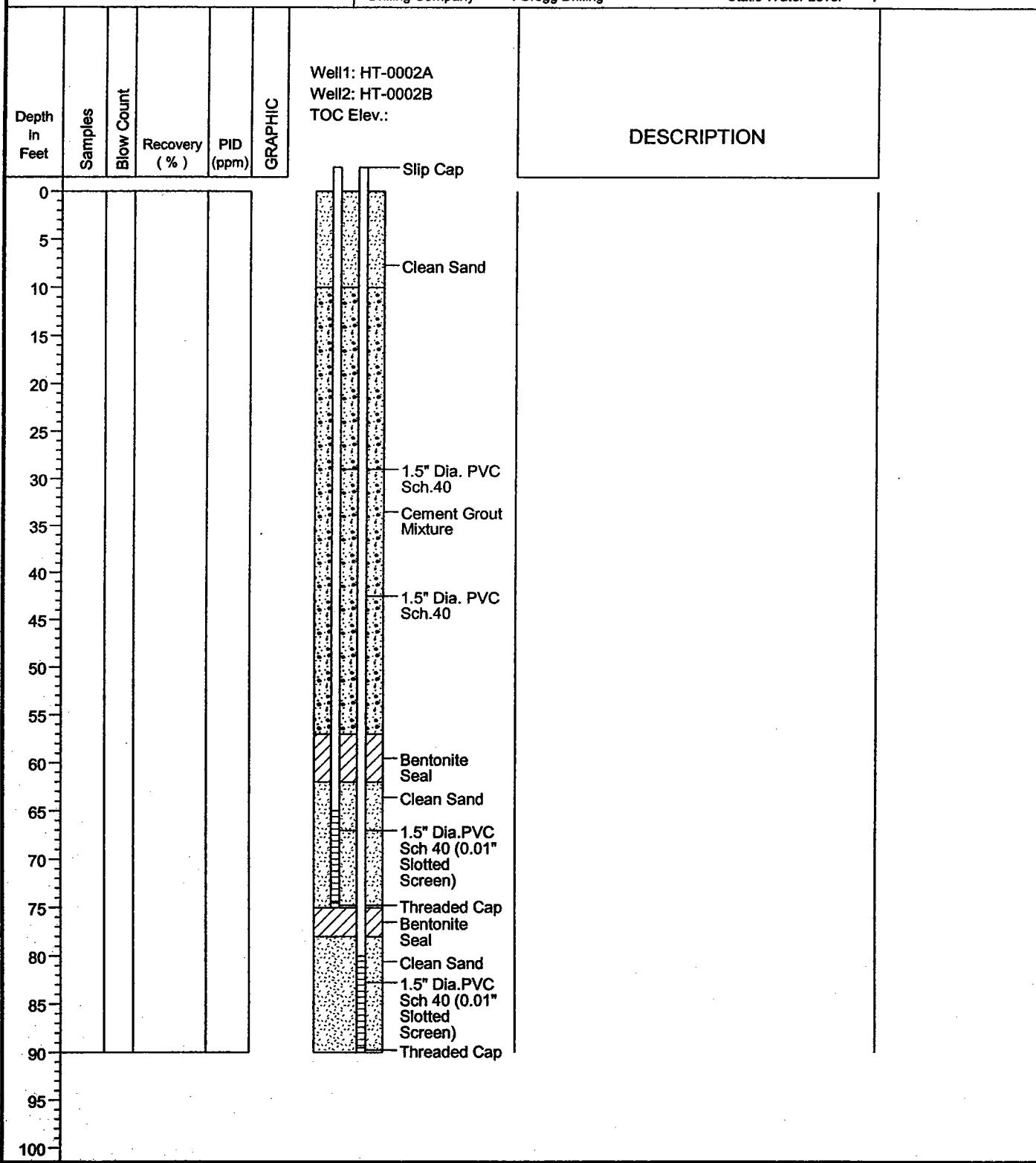
BORING LOG OF HT-0002

(Page 1 of 1)

Boeing - Torrance

CA000549.0001.00002

Date Started : June 25, 2002 Sampling Device : —
Date Completed : June 25, 2002 Drill Rig : MARL 12
Logged By : — Drillers : Tom, Sabino
Checked By : Olivia Edwards Diameter : 10-inch
Drilling Company : Gregg Drilling Static Water Level : —





BORING LOG OF HT-0003

(Page 1 of 4)

Boeing - Torrance

CA000549.0001.00002

Date Started : June 25, 2002 Sampling Device : Split Spoon
Date Completed : June 25, 2002 Drill Rig : HSA MARL 12
Logged By : Olivia Edwards Drillers : Tom, Sabino
Checked By : Olivia Edwards Diameter : 10-inches
Drilling Company : Gregg Drilling

Depth in Feet	Samples	Blow Count	Sample No.	Recovery (%)	PID (ppm)	GRAPHIC	Well1: HT-0003A Well2: HT-0003B TOC Elev.:	DESCRIPTION	
								Slip Cap	
0									
5	X	12 16 18	HT-003@5	100	0.0			Clean Sand	SILTY SAND, fine grained, yellowish brown (10YR 5/6), dry, dense, some angular gravel, <10% of matrix.
10	X	11 16 19	HT-003@10	100	0.0			1.5" Dia. PVC Sch.40	SANDY SILT, dark brown (10YR 3/6), dry, very stiff, some grayish mottling with some gravel, <10% of matrix.
15	X	5 9 10	HT-003@15	100	0.0			Cement Grout Mixture	SAND, very fine to fine grained, dark yellowish brown (10YR 4/4), damp, medium dense to dense.
20	X	10 15 21	HT-003@20	100	0.0				SAND, fine grained, light olive brown (2.5Y 5/4), damp, dense.
25									



BORING LOG OF HT-0003

(Page 2 of 4)

Boeing - Torrance

CA000549.0001.00002

Date Started : June 25, 2002
Date Completed : June 25, 2002
Logged By : Olivia Edwards
Checked By : Olivia Edwards
Drilling Company : Gregg Drilling

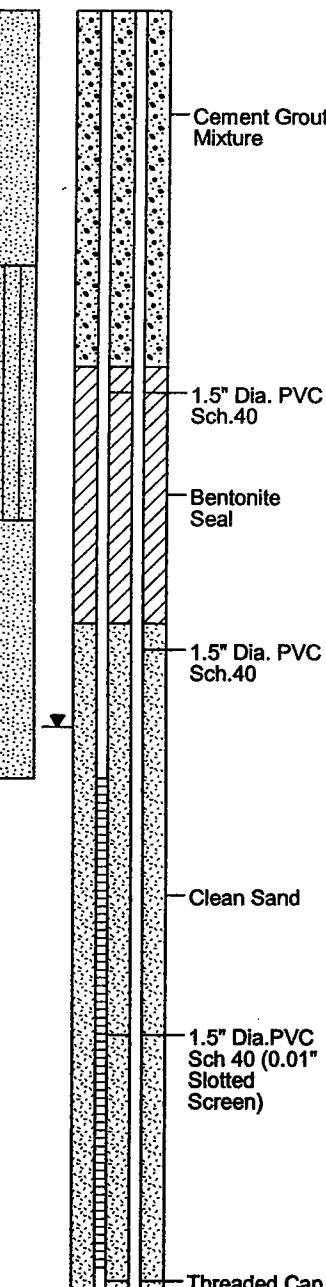
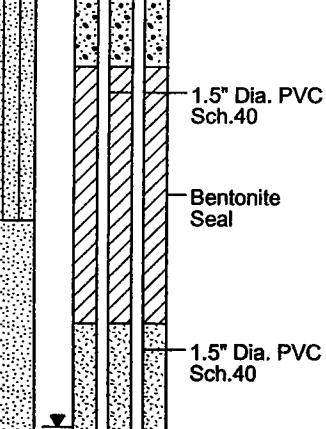
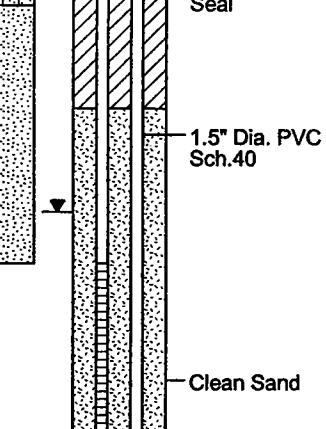
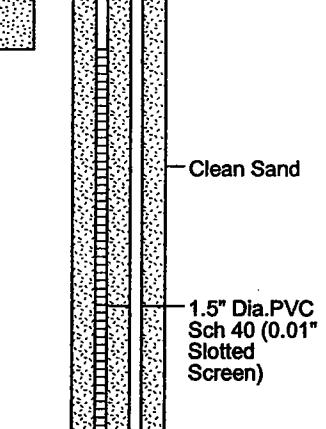
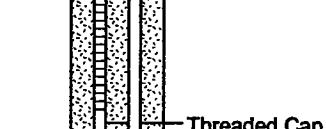
Sampling Device : Split Spoon
Drill Rig : HSA MARL 12
Drillers : Tom, Sabino
Diameter : 10-inches

Depth In Feet	Samples	Blow Count	Sample No.	Recovery (%)	PID (ppm)	GRAPHIC	Well1: HT-0003A Well2: HT-0003B TOC Elev.:	DESCRIPTION	
25		8 12 24	HT-003@25	100	0.0			SANDY CLAY, dark yellowish brown (10YR 4/4), damp, very stiff, some grayish to white mottling.	
30		21 35 43	HT-003@30	100	0.0			SAND, very fine to fine-grained, light yellowish brown (2.5Y 6/6), damp, very dense.	
35		16 24 28	HT-003@35	100	0.0		Cement Grout Mixture 1.5" Dia. PVC Sch.40	SANDY SILT, dark yellowish brown (10YR 4/4), damp, very stiff, grayish mottling. SAND, very fine to fine grained, light yellowish brown (2.5Y 6/3), very dense, damp, light grayish mottling.	
40		19 50 5	HT-003@40	100	0.0			SAND, very fine to fine-grained, light yellowish brown (2.5Y 6/3), moist, very dense, grayish mottling.	
45		18 21 24	HT-003@45	100	0.0			SAND, fine grained, light yellowish brown (2.5Y 6/4), damp, dense.	
50									



BORING LOG OF HT-0003

(Page 3 of 4)

Boeing - Torrance CA000549.0001.00002						Date Started : June 25, 2002 Date Completed : June 25, 2002 Logged By : Olivia Edwards Checked By : Olivia Edwards Drilling Company : Gregg Drilling	Sampling Device : Split Spoon Drill Rig : HSA MARL 12 Drillers : Tom, Sabino Diameter : 10-inches
Depth In Feet	Samples	Blow Count	Sample No.	Recovery (%)	PID (ppm)	GRAPHIC	DESCRIPTION
50	<input checked="" type="checkbox"/> 34 <input checked="" type="checkbox"/> 47 <input checked="" type="checkbox"/> 38		HT-003@50	100	0.0		Well1: HT-0003A Well2: HT-0003B TOC Elev.: GRAVELLY SAND, fine grained to coarse-grained, light yellowish brown (10YR 6/4), damp, dense to very dense, some subangular coarse gravel, shells and shell particles in <20% of matrix.
55	<input checked="" type="checkbox"/> 11 <input checked="" type="checkbox"/> 26 <input checked="" type="checkbox"/> 32		HT-003@55	100	0.2	 	SILTY SAND, fine grained, olive brown (2.5Y 4/4), damp, dense, slightly mottled.
60	<input checked="" type="checkbox"/> 31 <input checked="" type="checkbox"/> 24 <input checked="" type="checkbox"/> 44		HT-003@60	100	0.0		SAND, fine to medium grained sand, light brownish gray (2.5Y 6/2), damp, very dense.
65	<input checked="" type="checkbox"/> 24 <input checked="" type="checkbox"/> 44 <input checked="" type="checkbox"/> 50.5 <input checked="" type="checkbox"/> 33 <input checked="" type="checkbox"/> 50.5 <input checked="" type="checkbox"/> 35 <input checked="" type="checkbox"/> 50.5 <input checked="" type="checkbox"/> 17 <input checked="" type="checkbox"/> 40 <input checked="" type="checkbox"/> 45 <input checked="" type="checkbox"/> 27 <input checked="" type="checkbox"/> 38 <input checked="" type="checkbox"/> 29		HT-003@61.5 HT-003@62 HT-003@63.5 HT-003@64 HT-003@65	100 100 100 100 100	0.0 0.0 0.6 0.0 0.0		SILTY SAND, fine grained, olive brown (2.5Y 4/4), moist, very dense, some mottling Same as above. SAND, fine grained, dark grayish brown (2.5Y 4/2), moist, very dense, highly micaceous. Same as above - wet. Groundwater at ~64'. Same as above - saturated.
75							Total depth of boring = 90 feet.



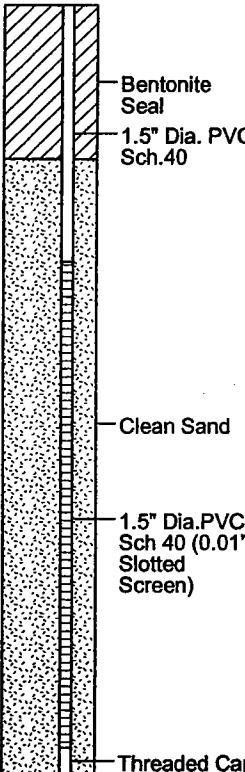
BORING LOG OF HT-0003

(Page 4 of 4)

Boeing - Torrance

CA000549.0001.00002

Date Started : June 25, 2002 Sampling Device : Split Spoon
Date Completed : June 25, 2002 Drill Rig : HSA MARL 12
Logged By : Olivia Edwards Drillers : Tom, Sabino
Checked By : Olivia Edwards Diameter : 10-inches
Drilling Company : Gregg Drilling

Depth in Feet	Samples	Blow Count	Sample No.	Recovery (%)	PID (ppm)	GRAPHIC	DESCRIPTION	
75							Well1: HT-0003A Well2: HT-0003B TOC Elev.:	

Appendix B

Cone Penetrometer Test Data

PRESENTATION OF CONE PENETRATION TEST DATA

BOEING BUILDING 2

LOS ANGELES, CALIFORNIA

Prepared for:

**ARCADIS G&M
Fullerton, California**

Prepared by:

**GREGG IN SITU, INC.
Signal Hill, California
02-145sh**

Prepared on:

June 29, 2002

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- Figure 2 PPDT Correlation Figure
- Figure 3 Soil Classification Chart
- References

ATTACHMENTS

- Computer Diskette with ASCII Files

PRESENTATION OF CONE PENETRATION TEST DATA

1.0 INTRODUCTION

This report presents the results of a Cone Penetration Testing (CPT) program carried out at the Boeing Building 2 site located in Los Angeles, CA. The work was performed on June 26th, 2002. The scope of work was performed as directed by Arcadis G&M personnel.

2.0 FIELD EQUIPMENT & PROCEDURES

The Cone Penetration Tests (CPT) were carried out by GREGG IN SITU, INC. of Signal Hill, CA using an integrated electronic cone system. The CPT soundings were performed in accordance with ASTM standards (D 5778-95). A 20 ton capacity cone was used for all of the soundings (figure 1). This cone has a tip area of 15 cm² and friction sleeve area of 225 cm². The cone is designed with an equal end area friction sleeve and a tip end area ratio of 0.85.

The cones used during the program recorded the following parameters at 5 cm depth intervals:

- Tip Resistance (qc)
- Sleeve Friction (fs)
- Dynamic Pore Pressure (U)

The above parameters were printed simultaneously on a printer and stored on a computer diskette for future analysis and reference.

The pore water pressure element was located directly behind the cone tip. The pore water pressure element was 5.0 mm thick and consisted of porous plastic. Each of the elements were saturated in silicon oil under vacuum pressure prior to penetration. Pore pressure dissipations were recorded at 5 second intervals when appropriate during pauses in the penetration.

A complete set of baseline readings was taken prior to each sounding to determine temperature shifts and any zero load offsets. Monitoring base line readings ensures that the cone electronics are operating properly.

The cones were pushed using GREGG IN SITU's CPT rig, having a down pressure capacity of approximately 20 tons. One CPT sounding was performed. The penetration test was carried to depths of approximately 90 feet below ground surface. Test locations and depths were determined in the field by Arcadis G&M personnel.

GREGG IN SITU, INC.

June 29, 2002
02-145sh

ARCADIS G&M
Boeing Building 2
Los Angeles, Ca.

The CPT sample holes were grouted using our support rig. The grouting procedure consists of pushing a hollow CPT rod with a "knock out" plug back down the hole to the test hole termination depth. Grout is then pumped under pressure as the tremie pipe is pulled from the hole.

3.0 CONE PENETRATION TEST DATA & INTERPRETATION

The cone penetration test data is presented in graphical form. Penetration depths are referenced to existing ground surface. This data includes CPT logs of measured soil parameters and a computer tabulation of interpreted soil types along with additional geotechnical parameters and pore pressure dissipation data.

The stratigraphic interpretation is based on relationships between cone bearing (q_c), sleeve friction (f_s), and penetration pore pressure (U). The friction ratio (R_f), which is sleeve friction divided by cone bearing, is a calculated parameter which is used to infer soil behavior type. Generally, cohesive soils (clays) have high friction ratios, low cone bearing and generate large excess pore water pressures. Cohesionless soils (sands) have lower friction ratios, high cone bearing and generate little in the way of excess pore water pressures.

Pore Pressure Dissipation Tests (PPDT's) were taken at various intervals in order to measure hydrostatic water pressures and approximate depth to groundwater table. In addition, the PPDT data can be used to estimate the horizontal permeability (k_h) of the soil. The correlation to permeability is based on the time required for 50 percent of the measured dynamic pore pressure to dissipate (t_{50}). The PPDT correlation figure (figure 2) is provided in the Appendix.

The interpretation of soils encountered on this project was carried out using recent correlations developed by Robertson et al, 1988. It should be noted that it is not always possible to clearly identify a soil type based on q_c , f_s and U . In these situations, experience and judgement and an assessment of the pore pressure dissipation data should be used to infer the soil behavior type. The soil classification chart (figure 3) used to interpret soil types based on q_t and R_f is provided in the Appendix.

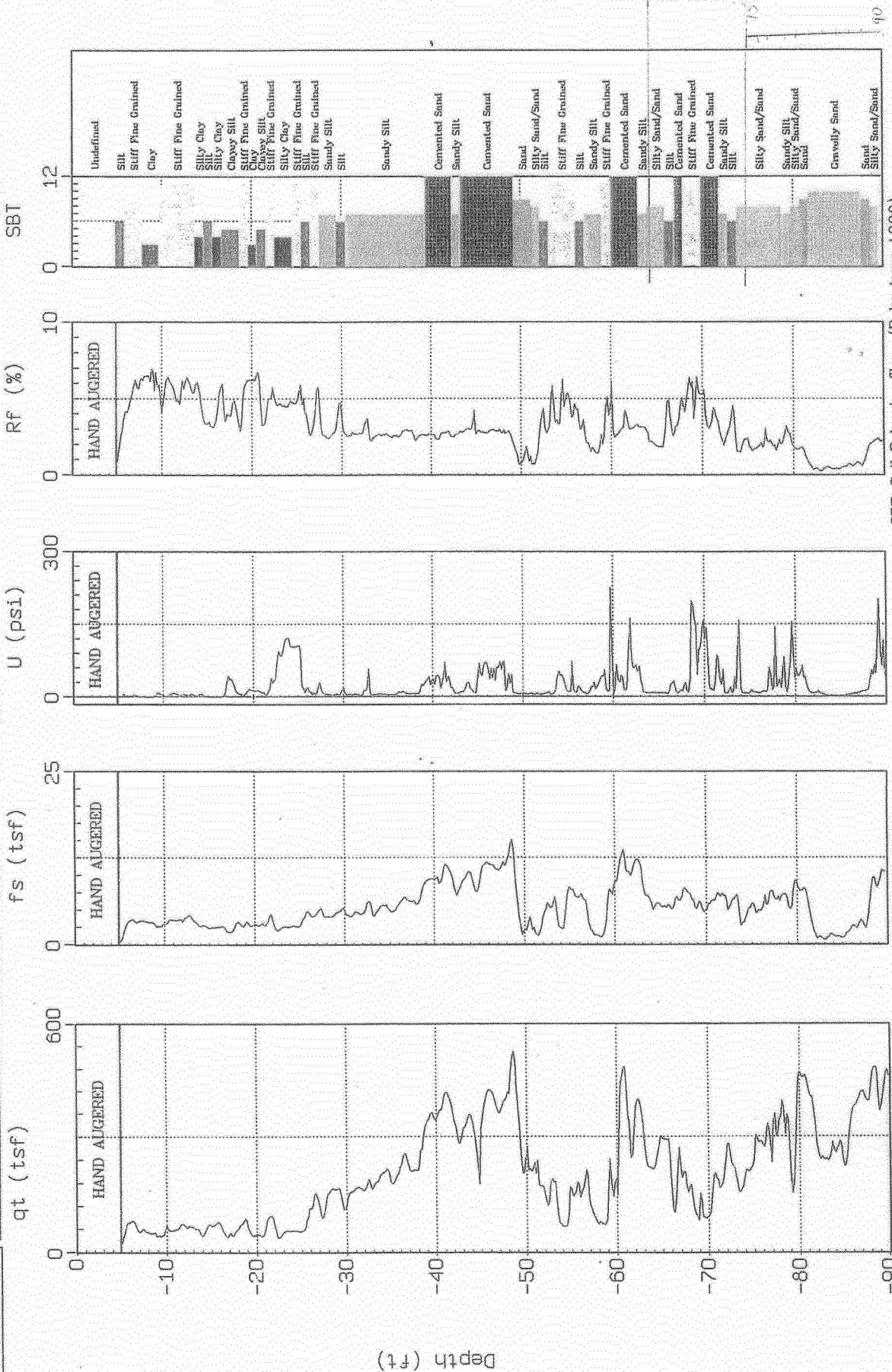
3.1 CPT PLOTS

GREGG

ARCADIS G&M

Site : BOEING BLDG. 2
Location : HT0001

Engineer : J. NGUYEN
Date : 06:26:02 07:59



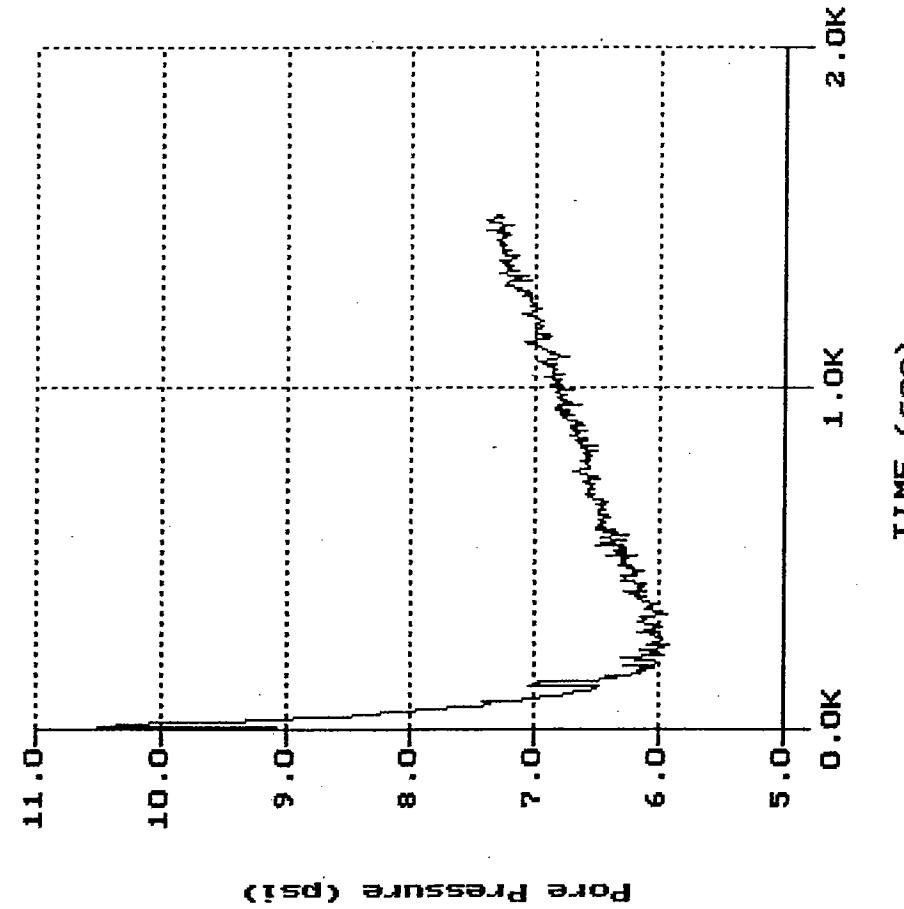
3.2 PORE PRESSURE DISSIPATION PLOTS

ARCADIS G&M

Site: BOEING BLDG. 2
Location: HT0001

Engineer: J. NGUYEN
Date: 06:26:02 07:59

PORE PRESSURE DISSIPATION RECORD



File: 145HT01.PPC
Depth (m) : 25.10
(ft) : 82.35
Duration : 1510.0s
U-min: 5.92 245.0s
U-max: 10.50 10.0s

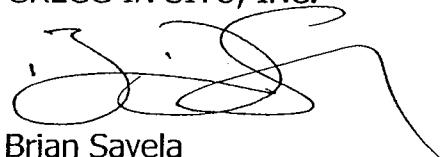
GREGG IN SITU, INC.

June 29, 2002
02-145sh

ARCADIS G&M
Boeing Building 2
Los Angeles, Ca.

We hope the information presented is sufficient for your purposes. We recommend that all data be carefully reviewed by qualified personnel to verify the data and make appropriate recommendations. If you have any questions, please do not hesitate to contact our office at (562) 427-6899.

Sincerely,
GREGG IN SITU, INC.



Brian Savela
Operations Manager

APPENDIX

ELECTRICAL PIEZOCONE

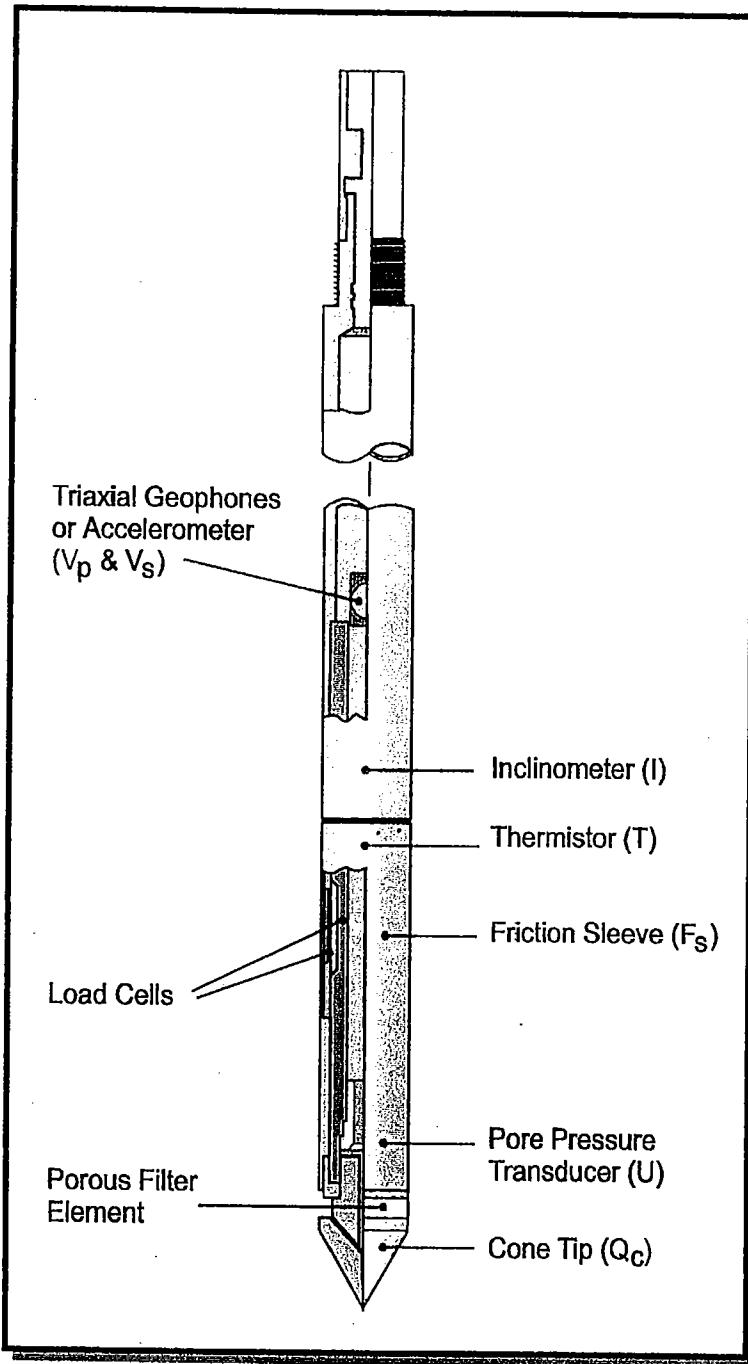
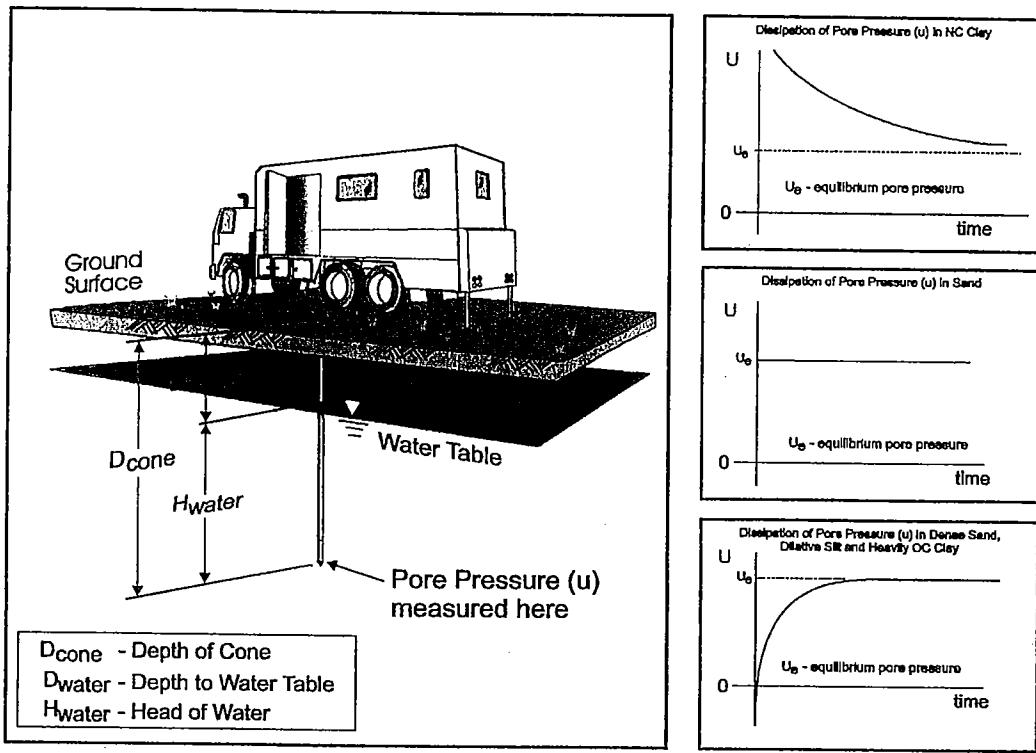


Figure 1

PPDT CORRELATION



Water Table Calculation

$$D_{water} = D_{cone} - H_{water}$$

where $H_{water} = U_e$ (depth units)

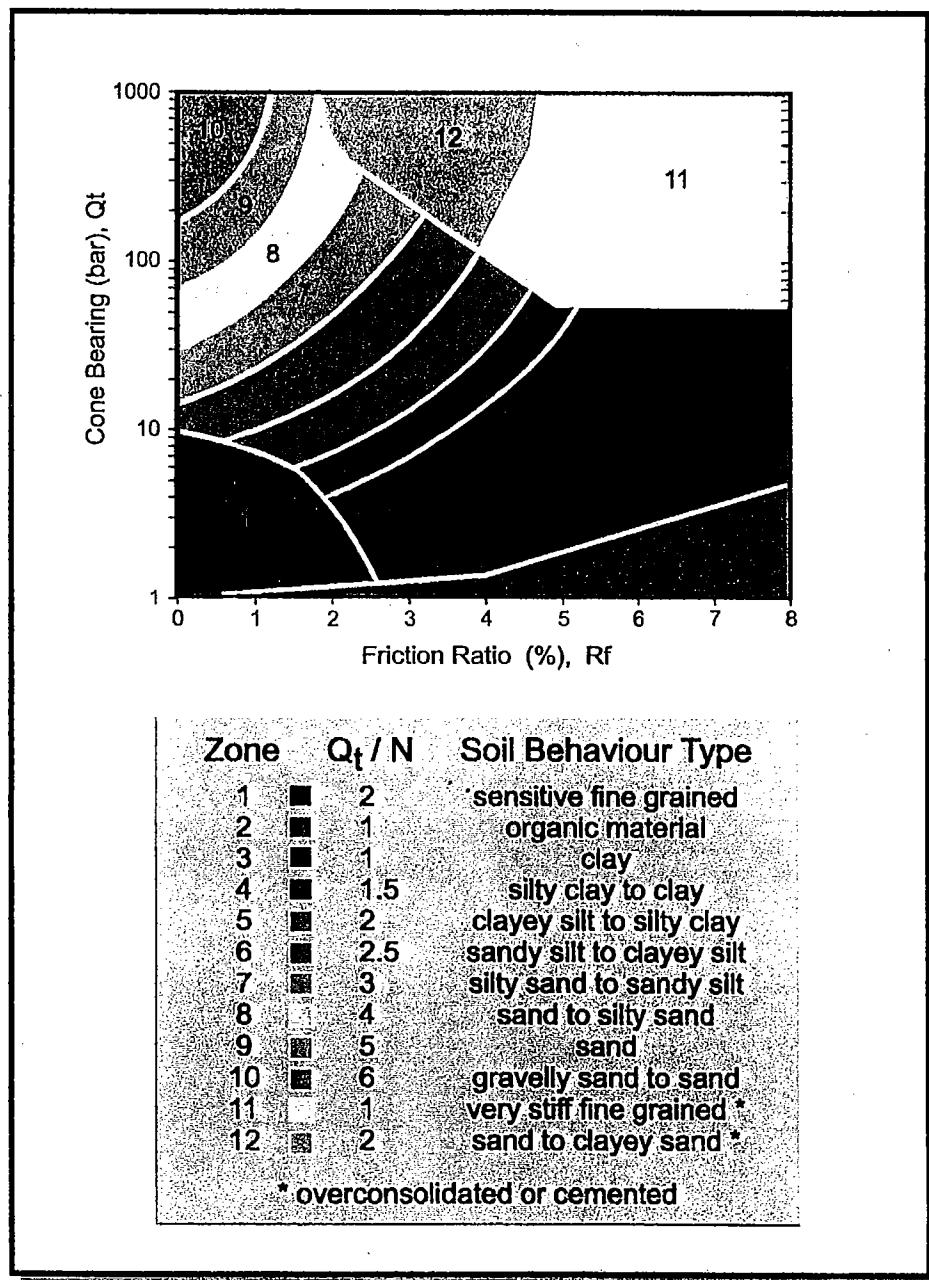
Useful Conversion Factors: $1\text{psi} = 0.704\text{m} = 2.31 \text{ feet (water)}$

$1\text{tsf} = 0.958 \text{ bar} = 13.9 \text{ psi}$

$1\text{m} = 3.28 \text{ feet}$

Figure 2

SOIL CLASSIFICATION CHART



After Robertson and Campenella

Figure 3

REFERENCES

- Robertson, P.K. and Campanella, R.G. and Wightman, A., 1983 "SPT-CPT Correlations", Journal of the Geotechnical Division, ASCE, Vol. 109, No. GT11, Nov., pp. 1449-1460.
- Robertson, P.K. and Wride C.E., 1998 "Evaluating Cyclic Liquefaction Potential Using The Cone Penetration Test", Journal of Geotechnical Division, Mar. 1998, pp. 442-459.
- Robertson, P.K. and Campanella, R.G., Gillespie, D. and Greig, J., 1986, "Use of Piezometer Cone Data", Proceedings of In Situ 86, ASCE Specialty Conference, Blacksburg, Virginia.
- Robertson, P.K. and Campanella, R.G., 1988, "Guidelines for Use, Interpretation and Application of the CPT and CPTU", UBC, Soil Mechanics Series No. 105, Civil Eng. Dept., Vancouver, B.C., V6T 1W5, Canada.
- Robertson, P.K., Campanella, R.G., Gillespie, D. and Rice, A., 1986, "Seismic CPT to Measure In Situ Shear Wave Velocity", Journal of Geotechnical Engineering, ASCE, Vol. 112, No. 8, pp. 791-803.

Appendix C
Slug Test Data From Minitroll

In-Situ Inc.

MiniTroll Pro

Report generated: 7/12/2002 10:20:47

Report from file:

DataMgr Version 3.7

Serial number: 8572

Firmware Version 3.04

Unit name: MW-0001A

Test name: Test #2

Test defined on: 7/11/2002 9:48:11

Test started on: 7/11/2002 9:48:53

Test stopped on: 7/11/2002 9:52:38

Test extracted on: N/A

Data gathered using Linear testing

Time between data points: Seconds.

Number of data samples: 226

TOTAL DATA SAMPLES 226

Channel number [2]

Measurement type: Pressure

Channel name: OnBoard Pressure

Sensor Range: 30 PSI.

Specific gravity: 1

Mode: TOC

User-defined reference: 68.26 Feet H2O

Referenced on: test start

Pressure head at reference: 5.797 Feet H2O

Date	Time	Chan[2]		Chan[2]	
		ET (sec)	Feet H2O	ET (sec)	Feet H2O
7/11/2002	9:48	0	68.26		
7/11/2002	9:48	1	68.26		
7/11/2002	9:48	2	68.258		
7/11/2002	9:48	3	68.262		
7/11/2002	9:48	4	68.26		
7/11/2002	9:48	5	68.258		
7/11/2002	9:48	6	68.273		
7/11/2002	9:49	7	68.27		
7/11/2002	9:49	8	68.256		
7/11/2002	9:49	9	68.256		
7/11/2002	9:49	10	68.255		
7/11/2002	9:49	11	68.423		
7/11/2002	9:49	12	68.474		
7/11/2002	9:49	13	68.568		
7/11/2002	9:49	14	68.619		
7/11/2002	9:49	15	68.56		
7/11/2002	9:49	16	68.708		
7/11/2002	9:49	17	68.749		
7/11/2002	9:49	18	69.433		

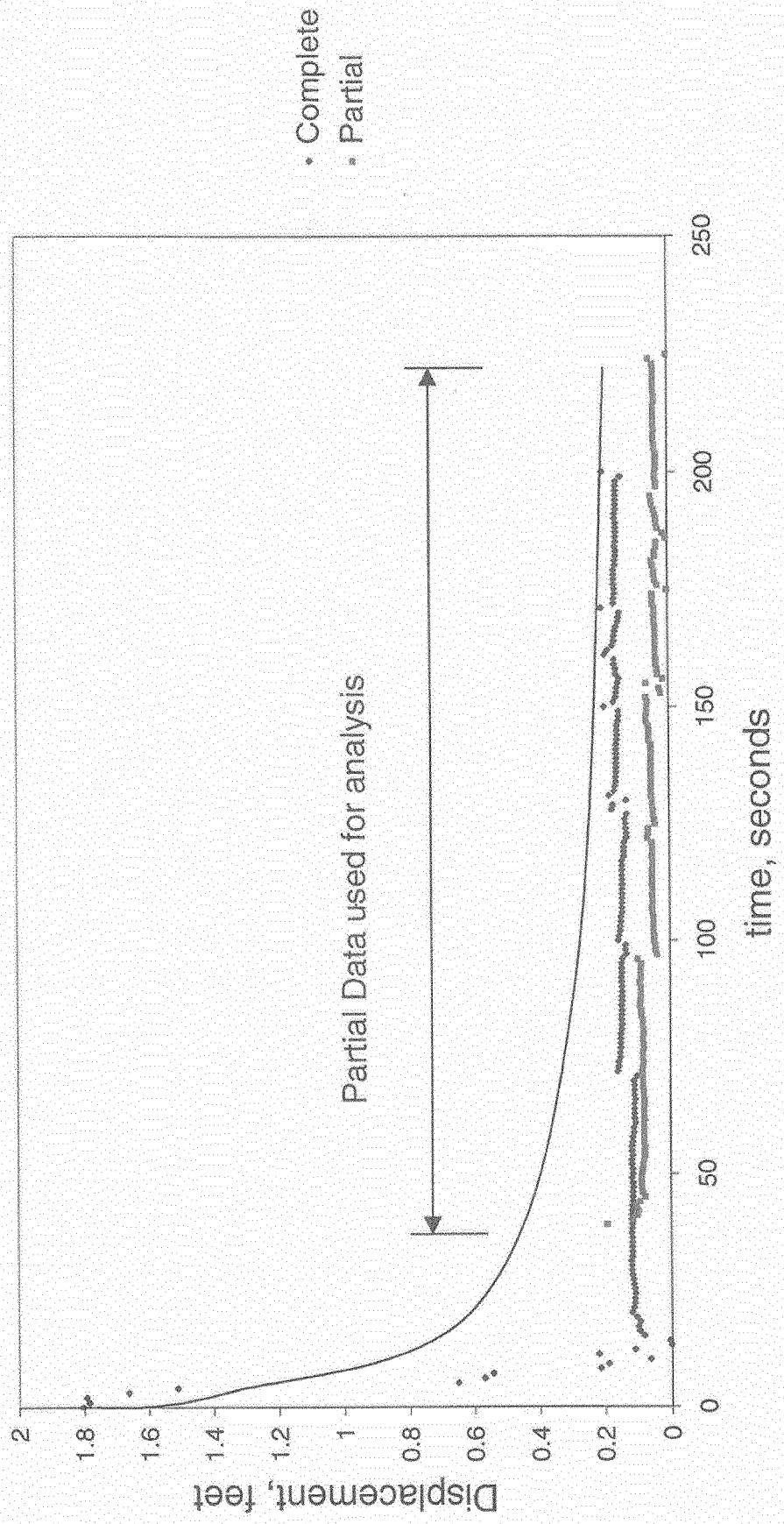
Date	Time		Chan[2] Feet H2O		Chan[2] Feet H2O
		ET (sec)		ET (sec)	
7/11/2002	9:49	19	69.757		
7/11/2002	9:49	20	69.752		
7/11/2002	9:49	21	69.763		
7/11/2002	9:49	22	69.773		
7/11/2002	9:49	23	69.862		
7/11/2002	9:49	24	69.839		
7/11/2002	9:49	25	69.873		
7/11/2002	9:49	26	69.854		
7/11/2002	9:49	27	69.862		
7/11/2002	9:49	28	69.733		
7/11/2002	9:49	29	69.582		
7/11/2002	9:49	30	68.721		
7/11/2002	9:49	31	68.64		
7/11/2002	9:49	32	68.613		
7/11/2002	9:49	33	68.285		
7/11/2002	9:49	34	68.26		
7/11/2002	9:49	35	68.134		
7/11/2002	9:49	36	68.291		
7/11/2002	9:49	37	68.181		
7/11/2002	9:49	38	68.07		
7/11/2002	9:49	39	68.075	0	0.192
7/11/2002	9:49	40	68.153	1	0.114
7/11/2002	9:49	41	68.166	2	0.101
7/11/2002	9:49	42	68.17	3	0.097
7/11/2002	9:49	43	68.164	4	0.103
7/11/2002	9:49	44	68.175	5	0.092
7/11/2002	9:49	45	68.189	6	0.078
7/11/2002	9:49	46	68.183	7	0.084
7/11/2002	9:49	47	68.181	8	0.086
7/11/2002	9:49	48	68.181	9	0.086
7/11/2002	9:49	49	68.179	10	0.088
7/11/2002	9:49	50	68.181	11	0.086
7/11/2002	9:49	51	68.183	12	0.084
7/11/2002	9:49	52	68.185	13	0.082
7/11/2002	9:49	53	68.187	14	0.08
7/11/2002	9:49	54	68.189	15	0.078
7/11/2002	9:49	55	68.189	16	0.078
7/11/2002	9:49	56	68.191	17	0.076
7/11/2002	9:49	57	68.187	18	0.08
7/11/2002	9:49	58	68.187	19	0.08
7/11/2002	9:49	59	68.187	20	0.08
7/11/2002	9:49	60	68.187	21	0.08
7/11/2002	9:49	61	68.187	22	0.08
7/11/2002	9:49	62	68.189	23	0.078
7/11/2002	9:49	63	68.187	24	0.08
7/11/2002	9:49	64	68.187	25	0.08
7/11/2002	9:49	65	68.189	26	0.078
7/11/2002	9:49	66	68.189	27	0.078
7/11/2002	9:50	67	68.187	28	0.08
7/11/2002	9:50	68	68.187	29	0.08
7/11/2002	9:50	69	68.185	30	0.082
7/11/2002	9:50	70	68.185	31	0.082
7/11/2002	9:50	71	68.185	32	0.082
7/11/2002	9:50	72	68.183	33	0.084

Date	Time		Chan[2]		Chan[2]
		ET (sec)	Feet H2O	ET (sec)	Feet H2O
7/11/2002	9:50	73	68.185	34	0.082
7/11/2002	9:50	74	68.187	35	0.08
7/11/2002	9:50	75	68.185	36	0.082
7/11/2002	9:50	76	68.185	37	0.082
7/11/2002	9:50	77	68.187	38	0.08
7/11/2002	9:50	78	68.187	39	0.08
7/11/2002	9:50	79	68.185	40	0.082
7/11/2002	9:50	80	68.187	41	0.08
7/11/2002	9:50	81	68.187	42	0.08
7/11/2002	9:50	82	68.185	43	0.082
7/11/2002	9:50	83	68.185	44	0.082
7/11/2002	9:50	84	68.181	45	0.086
7/11/2002	9:50	85	68.181	46	0.086
7/11/2002	9:50	86	68.176	47	0.091
7/11/2002	9:50	87	68.178	48	0.089
7/11/2002	9:50	88	68.179	49	0.088
7/11/2002	9:50	89	68.179	50	0.088
7/11/2002	9:50	90	68.179	51	0.088
7/11/2002	9:50	91	68.176	52	0.091
7/11/2002	9:50	92	68.179	53	0.088
7/11/2002	9:50	93	68.179	54	0.088
7/11/2002	9:50	94	68.179	55	0.088
7/11/2002	9:50	95	68.181	56	0.086
7/11/2002	9:50	96	68.17	57	0.097
7/11/2002	9:50	97	68.229	58	0.038
7/11/2002	9:50	98	68.225	59	0.042
7/11/2002	9:50	99	68.225	60	0.042
7/11/2002	9:50	100	68.221	61	0.046
7/11/2002	9:50	101	68.221	62	0.046
7/11/2002	9:50	102	68.219	63	0.048
7/11/2002	9:50	103	68.219	64	0.048
7/11/2002	9:50	104	68.219	65	0.048
7/11/2002	9:50	105	68.219	66	0.048
7/11/2002	9:50	106	68.217	67	0.05
7/11/2002	9:50	107	68.215	68	0.052
7/11/2002	9:50	108	68.217	69	0.05
7/11/2002	9:50	109	68.217	70	0.05
7/11/2002	9:50	110	68.215	71	0.052
7/11/2002	9:50	111	68.217	72	0.05
7/11/2002	9:50	112	68.215	73	0.052
7/11/2002	9:50	113	68.215	74	0.052
7/11/2002	9:50	114	68.215	75	0.052
7/11/2002	9:50	115	68.215	76	0.052
7/11/2002	9:50	116	68.217	77	0.05
7/11/2002	9:50	117	68.217	78	0.05
7/11/2002	9:50	118	68.215	79	0.052
7/11/2002	9:50	119	68.217	80	0.05
7/11/2002	9:50	120	68.216	81	0.051
7/11/2002	9:50	121	68.214	82	0.053
7/11/2002	9:50	122	68.202	83	0.065
7/11/2002	9:50	123	68.204	84	0.063
7/11/2002	9:50	124	68.204	85	0.063
7/11/2002	9:50	125	68.225	86	0.042
7/11/2002	9:50	126	68.223	87	0.044

Date	Time		Chan[2]		Chan[2]
		ET (sec)	Feet H2O	ET (sec)	Feet H2O
7/11/2002	9:51	127	68.219	88	0.048
7/11/2002	9:51	128	68.219	89	0.048
7/11/2002	9:51	129	68.217	90	0.05
7/11/2002	9:51	130	68.217	91	0.05
7/11/2002	9:51	131	68.214	92	0.053
7/11/2002	9:51	132	68.214	93	0.053
7/11/2002	9:51	133	68.214	94	0.053
7/11/2002	9:51	134	68.214	95	0.053
7/11/2002	9:51	135	68.214	96	0.053
7/11/2002	9:51	136	68.214	97	0.053
7/11/2002	9:51	137	68.213	98	0.054
7/11/2002	9:51	138	68.214	99	0.053
7/11/2002	9:51	139	68.214	100	0.053
7/11/2002	9:51	140	68.214	101	0.053
7/11/2002	9:51	141	68.214	102	0.053
7/11/2002	9:51	142	68.214	103	0.053
7/11/2002	9:51	143	68.208	104	0.059
7/11/2002	9:51	144	68.208	105	0.059
7/11/2002	9:51	145	68.208	106	0.059
7/11/2002	9:51	146	68.206	107	0.061
7/11/2002	9:51	147	68.2	108	0.067
7/11/2002	9:51	148	68.2	109	0.067
7/11/2002	9:51	149	68.202	110	0.065
7/11/2002	9:51	150	68.202	111	0.065
7/11/2002	9:51	151	68.204	112	0.063
7/11/2002	9:51	152	68.199	113	0.068
7/11/2002	9:51	153	68.244	114	0.023
7/11/2002	9:51	154	68.24	115	0.027
7/11/2002	9:51	155	68.2	116	0.067
7/11/2002	9:51	156	68.251	117	0.016
7/11/2002	9:51	157	68.236	118	0.031
7/11/2002	9:51	158	68.233	119	0.034
7/11/2002	9:51	159	68.231	120	0.036
7/11/2002	9:51	160	68.231	121	0.036
7/11/2002	9:51	161	68.229	122	0.038
7/11/2002	9:51	162	68.229	123	0.038
7/11/2002	9:51	163	68.229	124	0.038
7/11/2002	9:51	164	68.229	125	0.038
7/11/2002	9:51	165	68.229	126	0.038
7/11/2002	9:51	166	68.229	127	0.038
7/11/2002	9:51	167	68.229	128	0.038
7/11/2002	9:51	168	68.227	129	0.04
7/11/2002	9:51	169	68.227	130	0.04
7/11/2002	9:51	170	68.227	131	0.04
7/11/2002	9:51	171	68.227	132	0.04
7/11/2002	9:51	172	68.223	133	0.044
7/11/2002	9:51	173	68.221	134	0.046
7/11/2002	9:51	174	68.221	135	0.046
7/11/2002	9:51	175	68.265	136	0.002
7/11/2002	9:51	176	68.236	137	0.031
7/11/2002	9:51	177	68.229	138	0.038
7/11/2002	9:51	178	68.227	139	0.04
7/11/2002	9:51	179	68.227	140	0.04
7/11/2002	9:51	180	68.223	141	0.044

Date	Time	ET (sec)	Chan[2] Feet H2O	ET (sec)	Chan[2] Feet H2O
7/11/2002	9:51	181	68.219	142	0.048
7/11/2002	9:51	182	68.229	143	0.038
7/11/2002	9:51	183	68.229	144	0.038
7/11/2002	9:51	184	68.234	145	0.033
7/11/2002	9:51	185	68.233	146	0.034
7/11/2002	9:51	186	68.263	147	0.004
7/11/2002	9:52	187	68.253	148	0.014
7/11/2002	9:52	188	68.238	149	0.029
7/11/2002	9:52	189	68.234	150	0.033
7/11/2002	9:52	190	68.233	151	0.034
7/11/2002	9:52	191	68.231	152	0.036
7/11/2002	9:52	192	68.227	153	0.04
7/11/2002	9:52	193	68.221	154	0.046
7/11/2002	9:52	194	68.219	155	0.048
7/11/2002	9:52	195	68.217	156	0.05
7/11/2002	9:52	196	68.272	157	-0.005
7/11/2002	9:52	197	68.234	158	0.033
7/11/2002	9:52	198	68.233	159	0.034
7/11/2002	9:52	199	68.231	160	0.036
7/11/2002	9:52	200	68.231	161	0.036
7/11/2002	9:52	201	68.233	162	0.034
7/11/2002	9:52	202	68.233	163	0.034
7/11/2002	9:52	203	68.233	164	0.034
7/11/2002	9:52	204	68.233	165	0.034
7/11/2002	9:52	205	68.229	166	0.038
7/11/2002	9:52	206	68.229	167	0.038
7/11/2002	9:52	207	68.227	168	0.04
7/11/2002	9:52	208	68.227	169	0.04
7/11/2002	9:52	209	68.229	170	0.038
7/11/2002	9:52	210	68.227	171	0.04
7/11/2002	9:52	211	68.227	172	0.04
7/11/2002	9:52	212	68.227	173	0.04
7/11/2002	9:52	213	68.227	174	0.04
7/11/2002	9:52	214	68.227	175	0.04
7/11/2002	9:52	215	68.229	176	0.038
7/11/2002	9:52	216	68.229	177	0.038
7/11/2002	9:52	217	68.227	178	0.04
7/11/2002	9:52	218	68.227	179	0.04
7/11/2002	9:52	219	68.227	180	0.04
7/11/2002	9:52	220	68.227	181	0.04
7/11/2002	9:52	221	68.227	182	0.04
7/11/2002	9:52	222	68.227	183	0.04
7/11/2002	9:52	223	68.225	184	0.042
7/11/2002	9:52	224	68.212	185	0.055
7/11/2002	9:52	225	68.267	186	0

Groundwater Recharge - MW0001A



Appendix D

Slug Test Analysis (Bouwer Rice Method) for MW-0001A using Complete Data Set

Data Set: G:\COMMON\SGANDHI\BOEING\BOEING~1\MW0001A.AQT

Title: Test # 2 Boeing

Date: 10/21/02

Time: 09:04:24

AQUIFER DATA

Saturated Thickness: 7 ft

Anisotropy Ratio (Kz/Kr): 1

OBSERVATION WELL DATA

Number of observation wells: 1

Observation Well No. 1: MW0001A

X Location: 0 ft

Y Location: 0 ft

Observation Data

Time (sec) Displacement (ft)

0.	1.803
1.	1.784
2.	1.792
3.	1.663
4.	1.512
5.	0.651
6.	0.57
7.	0.543
8.	0.215
9.	0.19
10.	0.064
11.	0.221
12.	0.111
13.	0.
14.	0.005
15.	0.083
16.	0.096
17.	0.1
18.	0.094
19.	0.105
20.	0.119
21.	0.113
22.	0.111
23.	0.111
24.	0.109
25.	0.111
26.	0.113
27.	0.115
28.	0.117
29.	0.119
30.	0.119

31.	0.121
32.	0.117
33.	0.117
34.	0.117
35.	0.117
36.	0.117
37.	0.119
38.	0.117
39.	0.117
40.	0.119
41.	0.119
42.	0.117
43.	0.117
44.	0.115
45.	0.115
46.	0.115
47.	0.113
48.	0.115
49.	0.117
50.	0.115
51.	0.115
52.	0.117
53.	0.117
54.	0.115
55.	0.117
56.	0.117
57.	0.115
58.	0.115
59.	0.111
60.	0.111
61.	0.106
62.	0.108
63.	0.109
64.	0.109
65.	0.109
66.	0.106
67.	0.109
68.	0.109
69.	0.109
70.	0.111
71.	0.1
72.	0.159
73.	0.155
74.	0.155
75.	0.151
76.	0.151
77.	0.149
78.	0.149
79.	0.149
80.	0.149
81.	0.147
82.	0.145

83.	0.147
84.	0.147
85.	0.145
86.	0.147
87.	0.145
88.	0.145
89.	0.145
90.	0.145
91.	0.147
92.	0.147
93.	0.145
94.	0.147
95.	0.146
96.	0.144
97.	0.132
98.	0.134
99.	0.134
100.	0.155
101.	0.153
102.	0.149
103.	0.149
104.	0.147
105.	0.147
106.	0.144
107.	0.144
108.	0.144
109.	0.144
110.	0.144
111.	0.144
112.	0.143
113.	0.144
114.	0.144
115.	0.144
116.	0.144
117.	0.144
118.	0.138
119.	0.138
120.	0.138
121.	0.136
122.	0.13
123.	0.13
124.	0.132
125.	0.132
126.	0.134
127.	0.129
128.	0.174
129.	0.17
130.	0.13
131.	0.181
132.	0.166
133.	0.163
134.	0.161

135.	0.161
136.	0.159
137.	0.159
138.	0.159
139.	0.159
140.	0.159
141.	0.159
142.	0.159
143.	0.157
144.	0.157
145.	0.157
146.	0.157
147.	0.153
148.	0.151
149.	0.151
150.	0.195
151.	0.166
152.	0.159
153.	0.157
154.	0.157
155.	0.153
156.	0.149
157.	0.159
158.	0.159
159.	0.164
160.	0.163
161.	0.193
162.	0.183
163.	0.168
164.	0.164
165.	0.163
166.	0.161
167.	0.157
168.	0.151
169.	0.149
170.	0.147
171.	0.202
172.	0.164
173.	0.163
174.	0.161
175.	0.161
176.	0.163
177.	0.163
178.	0.163
179.	0.163
180.	0.159
181.	0.159
182.	0.157
183.	0.157
184.	0.159
185.	0.157
186.	0.157

187.	0.157
188.	0.157
189.	0.157
190.	0.159
191.	0.159
192.	0.157
193.	0.157
194.	0.157
195.	0.157
196.	0.157
197.	0.157
198.	0.155
199.	0.142
200.	0.197

SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.001269	ft/sec
y0	2.184	ft

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	
K	0.0008017	6.424E-05	ft/sec
y0	2.184	0.112	ft

Parameter Correlations

	K	y0
K	1.00	0.64
y0	0.64	1.00

Residual Statistics

for weighted residuals

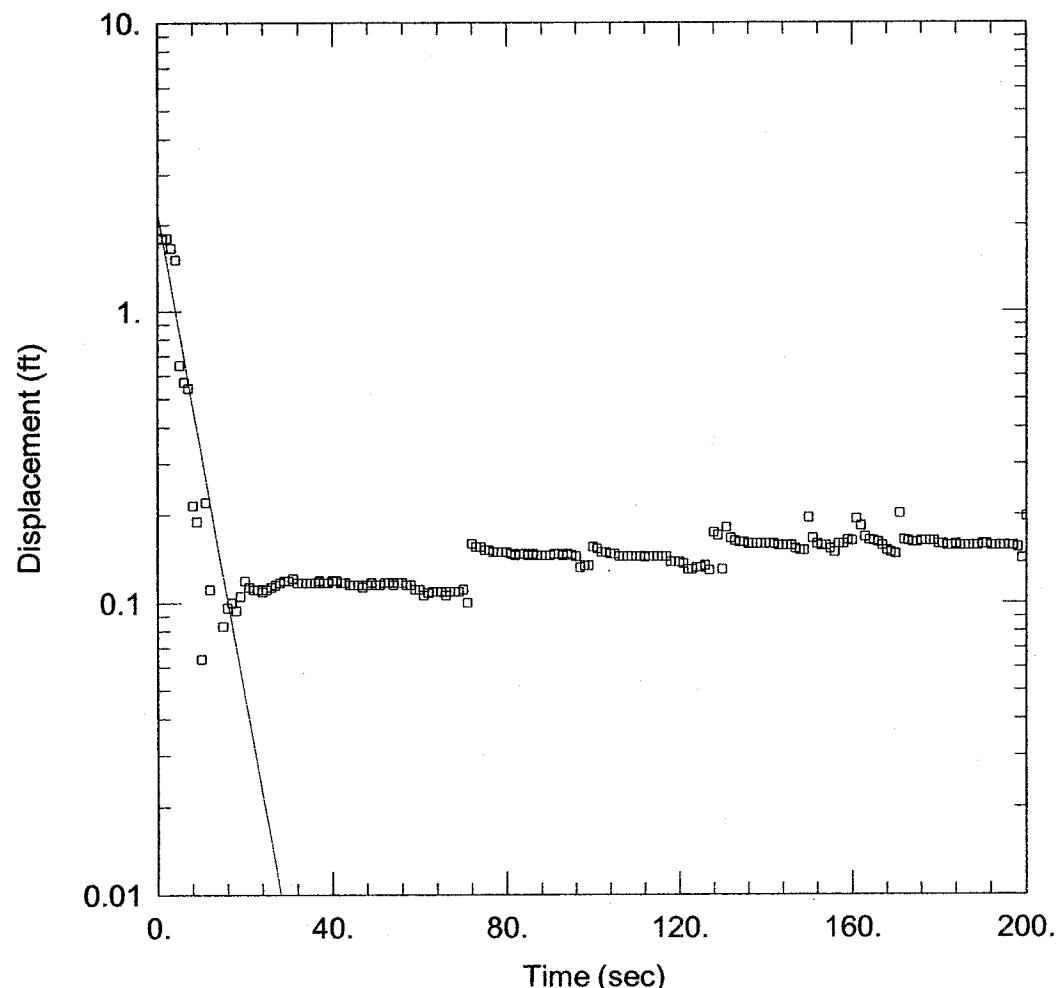
Sum of Squares ... 4.654 ft²
Variance..... 0.02339 ft²
Std. Deviation..... 0.1529 ft
Mean 0.1233 ft
No. of Residuals ... 201
No. of Estimates ... 2

Errors Detected in Data Set

No errors detected!

Options Available

Choose a solution to perform forward solution or curve matching analyses.



TEST # 2 BOEING

Data Set: G:\COMMON\SGANDH\BOEING\BOEING~1\MW0001A.AQT
 Date: 10/21/02 Time: 09:03:58

AQUIFER DATA

Saturated Thickness: 7. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 1.803 ft

Water Column Height: 7. ft

Casing Radius: 0.167 ft

Wellbore Radius: 0.33 ft

Screen Length: 15. ft

Gravel Pack Porosity: 0.3

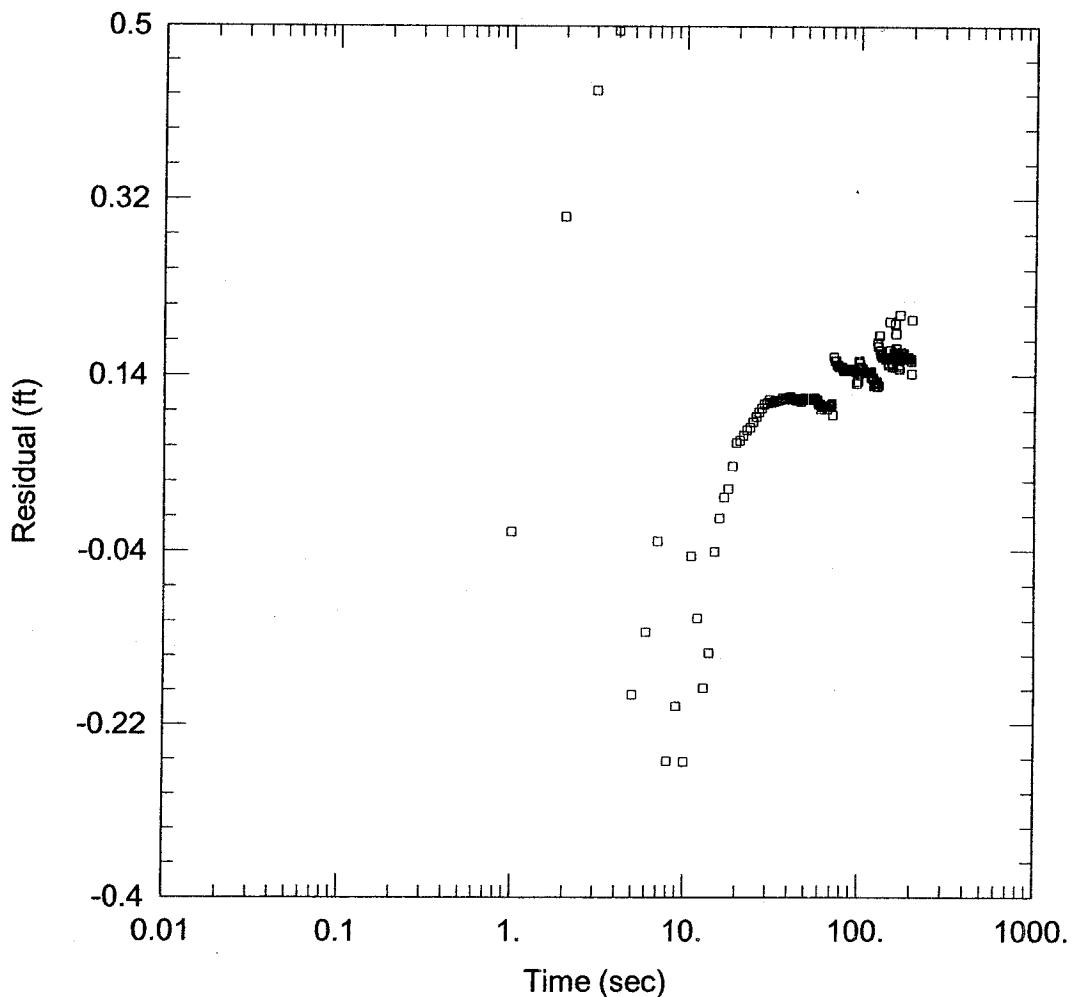
SOLUTION

Aquifer Model: Unconfined

$K = 0.0008017$ ft/sec

Solution Method: Bouwer-Rice

$y_0 = 2.184$ ft



TEST # 2 BOEING

Data Set: G:\COMMON\SGANDHI\BOEING\BOEING~1\MW0001A.AQT
 Date: 10/21/02 Time: 09:04:07

AQUIFER DATA

Saturated Thickness: 7. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 1.803 ft

Water Column Height: 7. ft

Casing Radius: 0.167 ft

Wellbore Radius: 0.33 ft

Screen Length: 15. ft

Gravel Pack Porosity: 0.3

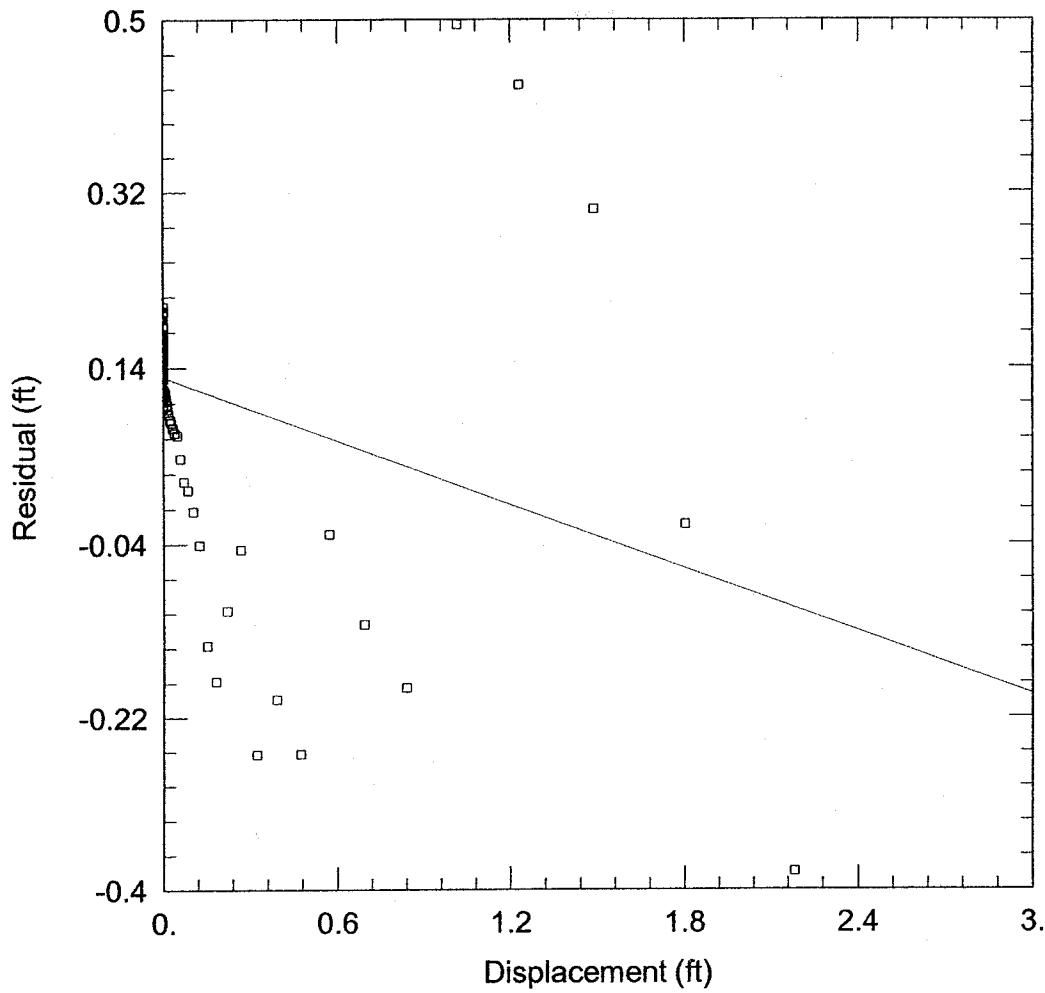
SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

K = 0.0008017 ft/sec

y0 = 2.184 ft



TEST # 2 BOEING

Data Set: G:\COMMON\GANDHI\BOEING\BOEING~1\MW0001A.AQT
 Date: 10/21/02 Time: 09:04:12

AQUIFER DATA

Saturated Thickness: 7. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 1.803 ft

Water Column Height: 7. ft

Casing Radius: 0.167 ft

Wellbore Radius: 0.33 ft

Screen Length: 15. ft

Gravel Pack Porosity: 0.3

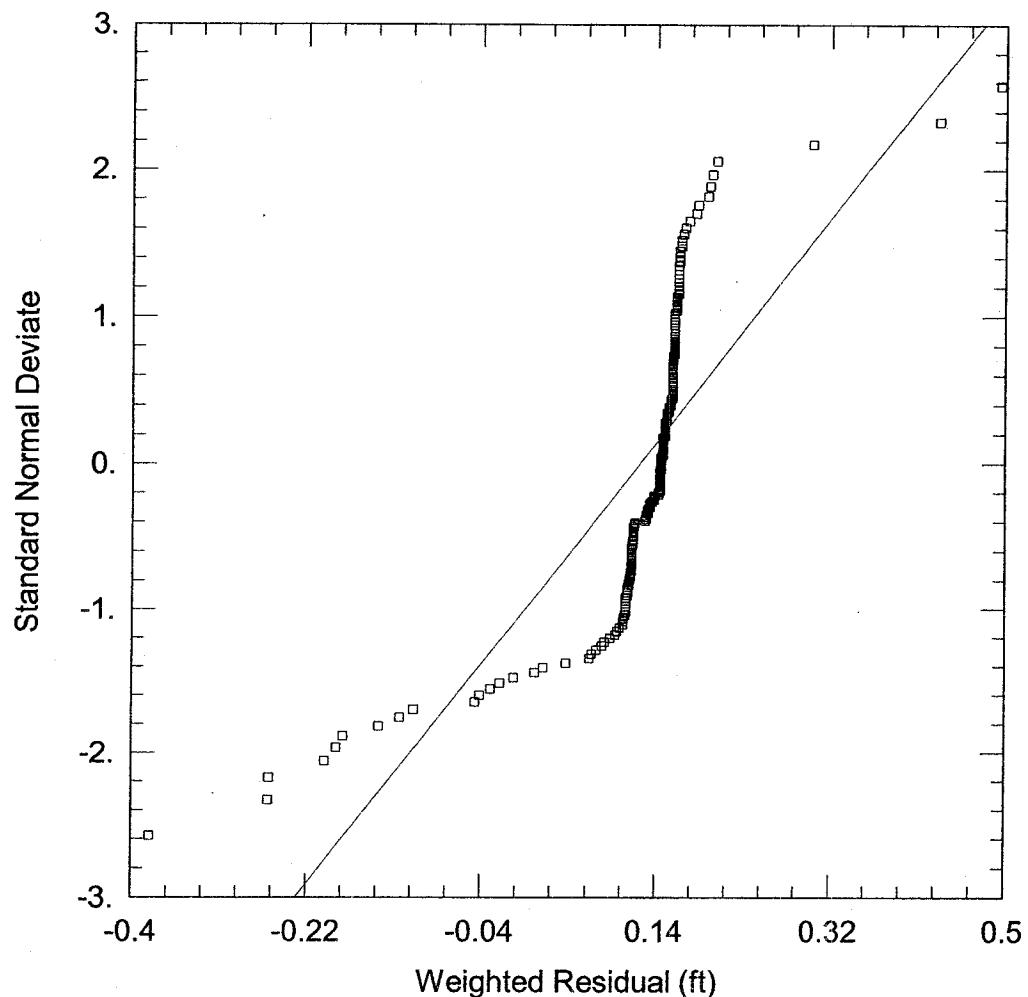
SOLUTION

Aquifer Model: Unconfined

K = 0.0008017 ft/sec

Solution Method: Bouwer-Rice

y0 = 2.184 ft



TEST # 2 BOEING

Data Set: G:\COMMON\SGANDHI\BOEING\BOEING~1\MW0001A.AQT
 Date: 10/21/02 Time: 09:04:16

AQUIFER DATA

Saturated Thickness: 7. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 1.803 ft

Casing Radius: 0.167 ft

Screen Length: 15. ft

Water Column Height: 7. ft

Wellbore Radius: 0.33 ft

Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

$K = 0.0008017 \text{ ft/sec}$

$y_0 = 2.184 \text{ ft}$

Diagnostic Statistics

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

Estimated Parameters

Parameter	Estimate	Std. Error	
K	0.0008017	6.424E-05	ft/sec
y0	2.184	0.112	ft

Parameter Correlations

	K	y0
K	1.00	0.64
y0	0.64	1.00

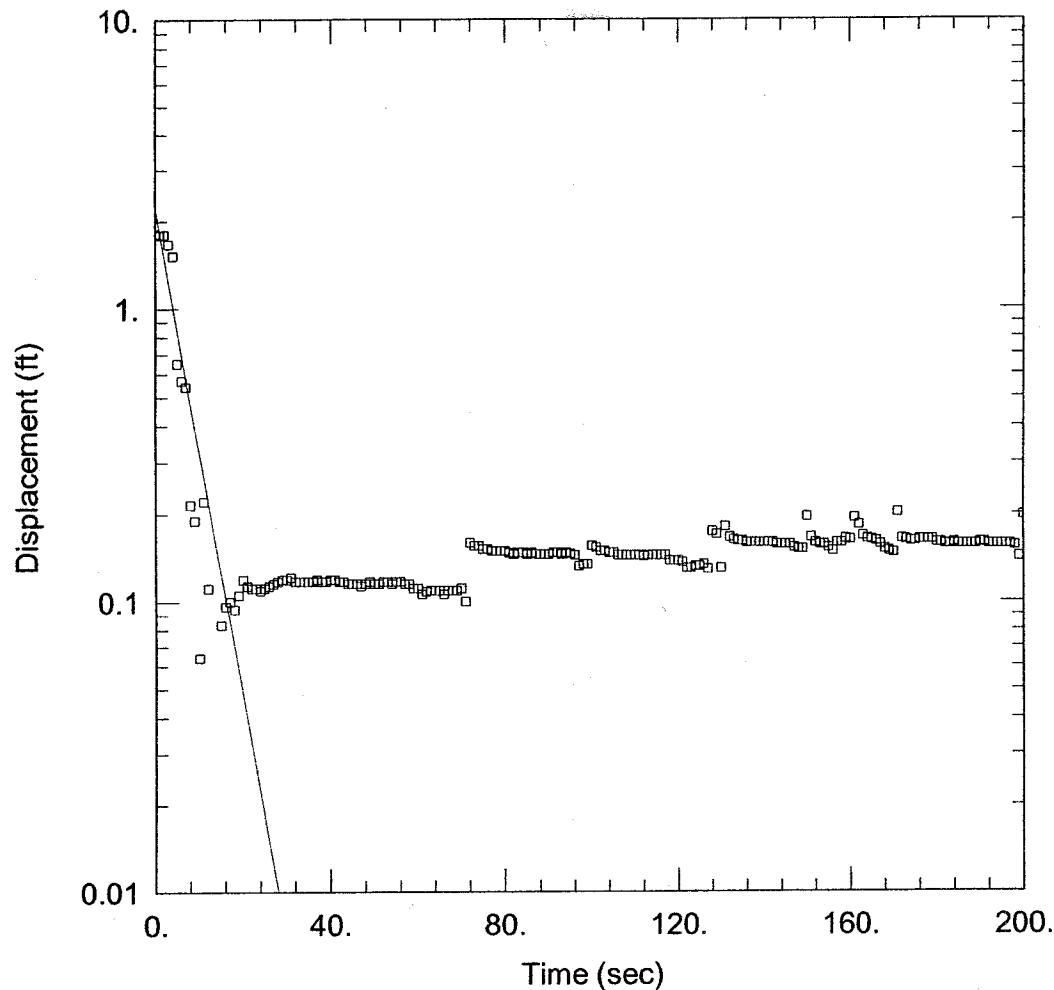
Residual Statistics

for weighted residuals

Sum of Squares ... 4.654 ft²
Variance..... 0.02339 ft²
Std. Deviation..... 0.1529 ft
Mean 0.1233 ft
No. of Residuals ... 201
No. of Estimates ... 2

Appendix E

Slug Test Analysis (Hvorslev Method) for MW-0001A Using Complete Data Set



TEST # 2 BOEING

Data Set: G:\COMMON\SGANDHI\BOEING\BOEING~1\MW0001A.AQT
 Date: 10/21/02 Time: 08:59:23

AQUIFER DATA

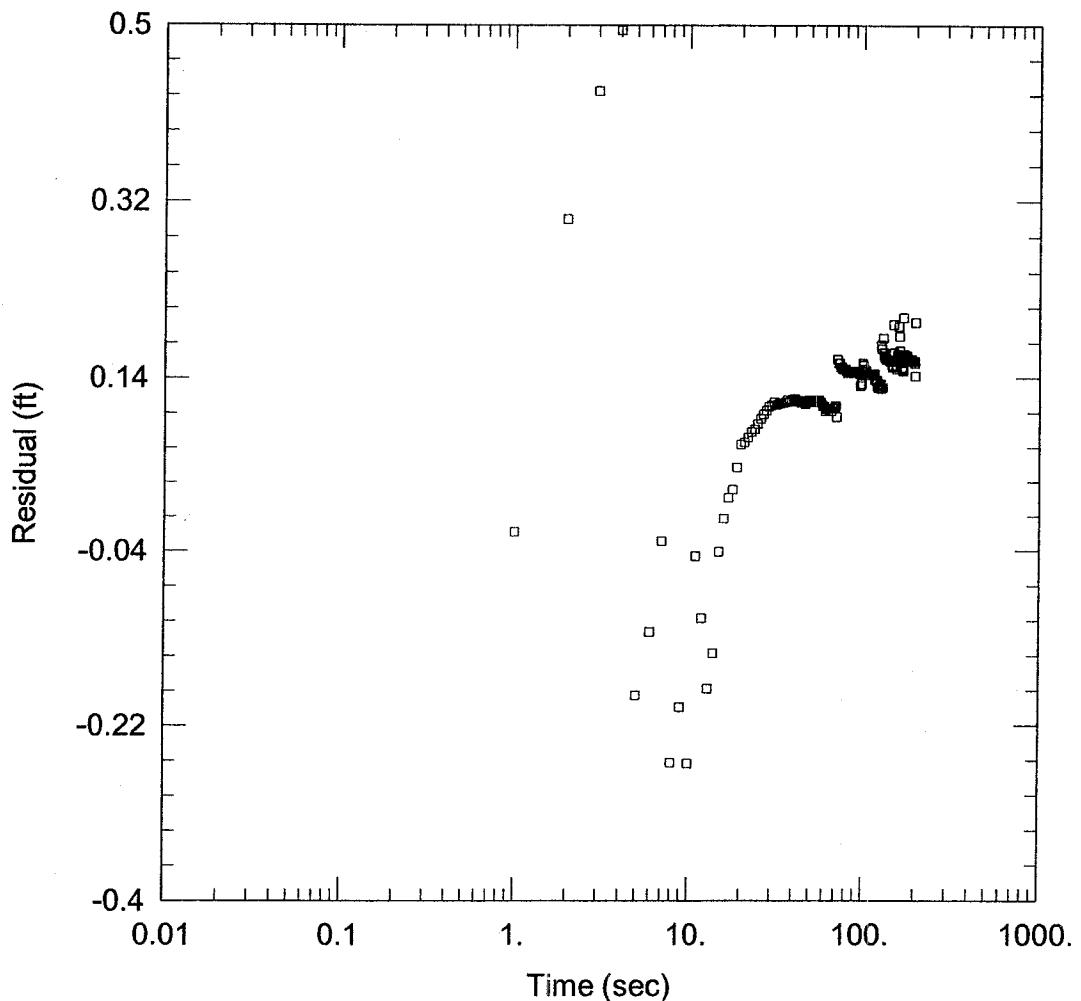
Saturated Thickness: 7. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 1.803 ft Water Column Height: 7. ft
 Casing Radius: 0.167 ft Wellbore Radius: 0.33 ft
 Screen Length: 15. ft Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined K = 0.001269 ft/sec
 Solution Method: Hvorslev y0 = 2.184 ft



TEST # 2 BOEING

Data Set: G:\COMMON\SGANDHI\BOEING\BOEING~1\MW0001A.AQT
 Date: 10/21/02 Time: 08:59:28

AQUIFER DATA

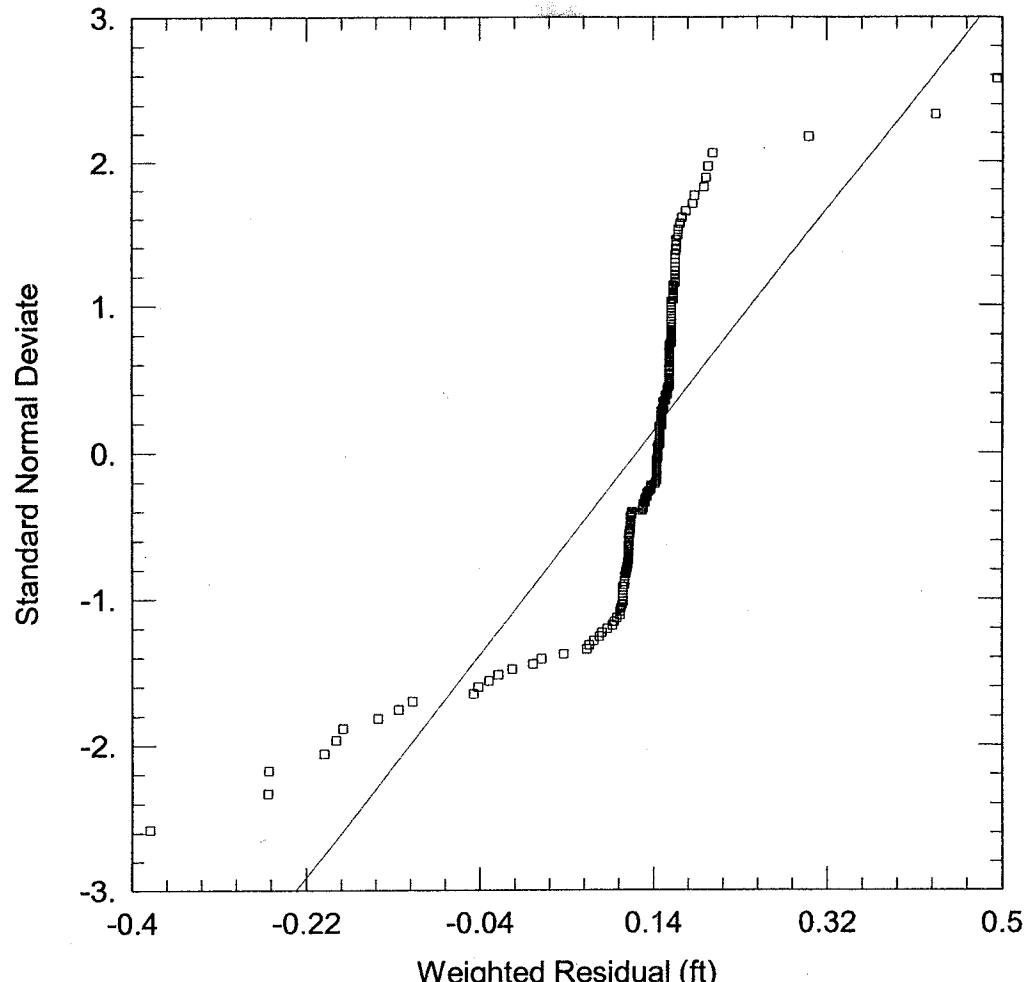
Saturated Thickness: 7. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 1.803 ft Water Column Height: 7. ft
 Casing Radius: 0.167 ft Wellbore Radius: 0.33 ft
 Screen Length: 15. ft Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined $K = 0.001269$ ft/sec
 Solution Method: Hvorslev $y_0 = 2.184$ ft



TEST # 2 BOEING

Data Set: G:\COMMON\SGANDHI\BOEING\BOEING~1\MW0001A.AQT
 Date: 10/21/02 Time: 08:59:33

AQUIFER DATA

Saturated Thickness: 7. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 1.803 ft
 Casing Radius: 0.167 ft
 Screen Length: 15. ft

Water Column Height: 7. ft
 Wellbore Radius: 0.33 ft
 Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
 Solution Method: Hvorslev

$K = 0.001269$ ft/sec
 $y_0 = 2.184$ ft

Diagnostic Statistics

Aquifer Model: Unconfined
Solution Method: Hvorslev

Estimated Parameters

Parameter	Estimate	Std. Error	
K	0.001269	0.0001017	ft/sec
y0	2.184	0.112	ft

Parameter Correlations

	K	y0
K	1.00	0.64
y0	0.64	1.00

Residual Statistics

for weighted residuals

Sum of Squares ... 4.654 ft²
Variance..... 0.02339 ft²
Std. Deviation..... 0.1529 ft
Mean 0.1233 ft
No. of Residuals ... 201
No. of Estimates ... 2

Data Set: G:\COMMON\SGANDHI\BOEING\BOEING~1\MW0001A.AQT

Title: Test # 2 Boeing

Date: 10/21/02

Time: 08:59:47

AQUIFER DATA

Saturated Thickness: 7 ft

Anisotropy Ratio (Kz/Kr): 1

OBSERVATION WELL DATA

Number of observation wells: 1

Observation Well No. 1: MW0001A

X Location: 0 ft

Y Location: 0 ft

Observation Data

Time (sec) Displacement (ft)

0.	1.803
1.	1.784
2.	1.792
3.	1.663
4.	1.512
5.	0.651
6.	0.57
7.	0.543
8.	0.215
9.	0.19
10.	0.064
11.	0.221
12.	0.111
13.	0.
14.	0.005
15.	0.083
16.	0.096
17.	0.1
18.	0.094
19.	0.105
20.	0.119
21.	0.113
22.	0.111
23.	0.111
24.	0.109
25.	0.111
26.	0.113
27.	0.115
28.	0.117
29.	0.119
30.	0.119

31. 0.121
32. 0.117
33. 0.117
34. 0.117
35. 0.117
36. 0.117
37. 0.119
38. 0.117
39. 0.117
40. 0.119
41. 0.119
42. 0.117
43. 0.117
44. 0.115
45. 0.115
46. 0.115
47. 0.113
48. 0.115
49. 0.117
50. 0.115
51. 0.115
52. 0.117
53. 0.117
54. 0.115
55. 0.117
56. 0.117
57. 0.115
58. 0.115
59. 0.111
60. 0.111
61. 0.106
62. 0.108
63. 0.109
64. 0.109
65. 0.109
66. 0.106
67. 0.109
68. 0.109
69. 0.109
70. 0.111
71. 0.1
72. 0.159
73. 0.155
74. 0.155
75. 0.151
76. 0.151
77. 0.149
78. 0.149
79. 0.149
80. 0.149
81. 0.147
82. 0.145

83.	0.147
84.	0.147
85.	0.145
86.	0.147
87.	0.145
88.	0.145
89.	0.145
90.	0.145
91.	0.147
92.	0.147
93.	0.145
94.	0.147
95.	0.146
96.	0.144
97.	0.132
98.	0.134
99.	0.134
100.	0.155
101.	0.153
102.	0.149
103.	0.149
104.	0.147
105.	0.147
106.	0.144
107.	0.144
108.	0.144
109.	0.144
110.	0.144
111.	0.144
112.	0.143
113.	0.144
114.	0.144
115.	0.144
116.	0.144
117.	0.144
118.	0.138
119.	0.138
120.	0.138
121.	0.136
122.	0.13
123.	0.13
124.	0.132
125.	0.132
126.	0.134
127.	0.129
128.	0.174
129.	0.17
130.	0.13
131.	0.181
132.	0.166
133.	0.163
134.	0.161

135.	0.161
136.	0.159
137.	0.159
138.	0.159
139.	0.159
140.	0.159
141.	0.159
142.	0.159
143.	0.157
144.	0.157
145.	0.157
146.	0.157
147.	0.153
148.	0.151
149.	0.151
150.	0.195
151.	0.166
152.	0.159
153.	0.157
154.	0.157
155.	0.153
156.	0.149
157.	0.159
158.	0.159
159.	0.164
160.	0.163
161.	0.193
162.	0.183
163.	0.168
164.	0.164
165.	0.163
166.	0.161
167.	0.157
168.	0.151
169.	0.149
170.	0.147
171.	0.202
172.	0.164
173.	0.163
174.	0.161
175.	0.161
176.	0.163
177.	0.163
178.	0.163
179.	0.163
180.	0.159
181.	0.159
182.	0.157
183.	0.157
184.	0.159
185.	0.157
186.	0.157

187.	0.157
188.	0.157
189.	0.157
190.	0.159
191.	0.159
192.	0.157
193.	0.157
194.	0.157
195.	0.157
196.	0.157
197.	0.157
198.	0.155
199.	0.142
200.	0.197

SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.001269	ft/sec
y0	1.638	ft

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	
K	0.001269	0.0001017	ft/sec
y0	2.184	0.112	ft

Parameter Correlations

	K	y0
K	1.00	0.64
y0	0.64	1.00

Residual Statistics

for weighted residuals

Sum of Squares ... 4.654 ft²
Variance..... 0.02339 ft²
Std. Deviation..... 0.1529 ft
Mean 0.1233 ft
No. of Residuals ... 201
No. of Estimates ... 2

Errors Detected in Data Set

No errors detected!

Options Available

Choose a solution to perform forward solution or curve matching analyses.

Appendix F

Slug Test Analysis (Bouwer-Rice Method) for MW-0001A Using Partial Data Set

Data Set: G:\COMMON\SGANDHI\BOEING\BOEING~1\BMW01A.AQT

Title: Test # 2 Boeing

Date: 10/17/02

Time: 12:30:35

AQUIFER DATA

Saturated Thickness: 7 ft

Anisotropy Ratio (Kz/Kr): 1

OBSERVATION WELL DATA

Number of observation wells: 1

Observation Well No. 1: MW0001A

X Location: 0 ft

Y Location: 0 ft

Observation Data

Time (sec) Displacement (ft)

0.	0.192
1.	0.114
2.	0.101
3.	0.097
4.	0.103
5.	0.092
6.	0.078
7.	0.084
8.	0.086
9.	0.086
10.	0.088
11.	0.086
12.	0.084
13.	0.082
14.	0.08
15.	0.078
16.	0.078
17.	0.076
18.	0.08
19.	0.08
20.	0.08
21.	0.08
22.	0.08
23.	0.078
24.	0.08
25.	0.08
26.	0.078
27.	0.078
28.	0.08
29.	0.08
30.	0.082

31.	0.082
32.	0.082
33.	0.084
34.	0.082
35.	0.08
36.	0.082
37.	0.082
38.	0.08
39.	0.08
40.	0.082
41.	0.08
42.	0.08
43.	0.082
44.	0.082
45.	0.086
46.	0.086
47.	0.091
48.	0.089
49.	0.088
50.	0.088
51.	0.088
52.	0.091
53.	0.088
54.	0.088
55.	0.088
56.	0.086
57.	0.097
58.	0.038
59.	0.042
60.	0.042
61.	0.046
62.	0.046
63.	0.048
64.	0.048
65.	0.048
66.	0.048
67.	0.05
68.	0.052
69.	0.05
70.	0.05
71.	0.052
72.	0.05
73.	0.052
74.	0.052
75.	0.052
76.	0.052
77.	0.05
78.	0.05
79.	0.052
80.	0.05
81.	0.051
82.	0.053

83.	0.065
84.	0.063
85.	0.063
86.	0.042
87.	0.044
88.	0.048
89.	0.048
90.	0.05
91.	0.05
92.	0.053
93.	0.053
94.	0.053
95.	0.053
96.	0.053
97.	0.053
98.	0.054
99.	0.053
100.	0.053
101.	0.053
102.	0.053
103.	0.053
104.	0.059
105.	0.059
106.	0.059
107.	0.061
108.	0.067
109.	0.067
110.	0.065
111.	0.065
112.	0.063
113.	0.068
114.	0.023
115.	0.027
116.	0.067
117.	0.016
118.	0.031
119.	0.034
120.	0.036
121.	0.036
122.	0.038
123.	0.038
124.	0.038
125.	0.038
126.	0.038
127.	0.038
128.	0.038
129.	0.04
130.	0.04
131.	0.04
132.	0.04
133.	0.044
134.	0.046

135.	0.046
136.	0.002
137.	0.031
138.	0.038
139.	0.04
140.	0.04
141.	0.044
142.	0.048
143.	0.038
144.	0.038
145.	0.033
146.	0.034
147.	0.004
148.	0.014
149.	0.029
150.	0.033
151.	0.034
152.	0.036
153.	0.04
154.	0.046
155.	0.048
156.	0.05
157.	0.005
158.	0.033
159.	0.034
160.	0.036
161.	0.036
162.	0.034
163.	0.034
164.	0.034
165.	0.034
166.	0.038
167.	0.038
168.	0.04
169.	0.04
170.	0.038
171.	0.04
172.	0.04
173.	0.04
174.	0.04
175.	0.04
176.	0.038
177.	0.038
178.	0.04
179.	0.04
180.	0.04
181.	0.04
182.	0.04
183.	0.04
184.	0.042
185.	0.055
186.	0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

VISUAL ESTIMATION RESULTS**Estimated Parameters**

Parameter	Estimate
K	0.0001203 ft/sec
y0	0.09889 ft

AUTOMATIC ESTIMATION RESULTS**Estimated Parameters**

Parameter	Estimate	Std. Error
K	0.0001203	6.439E-06 ft/sec
y0	0.09889	0.002613 ft

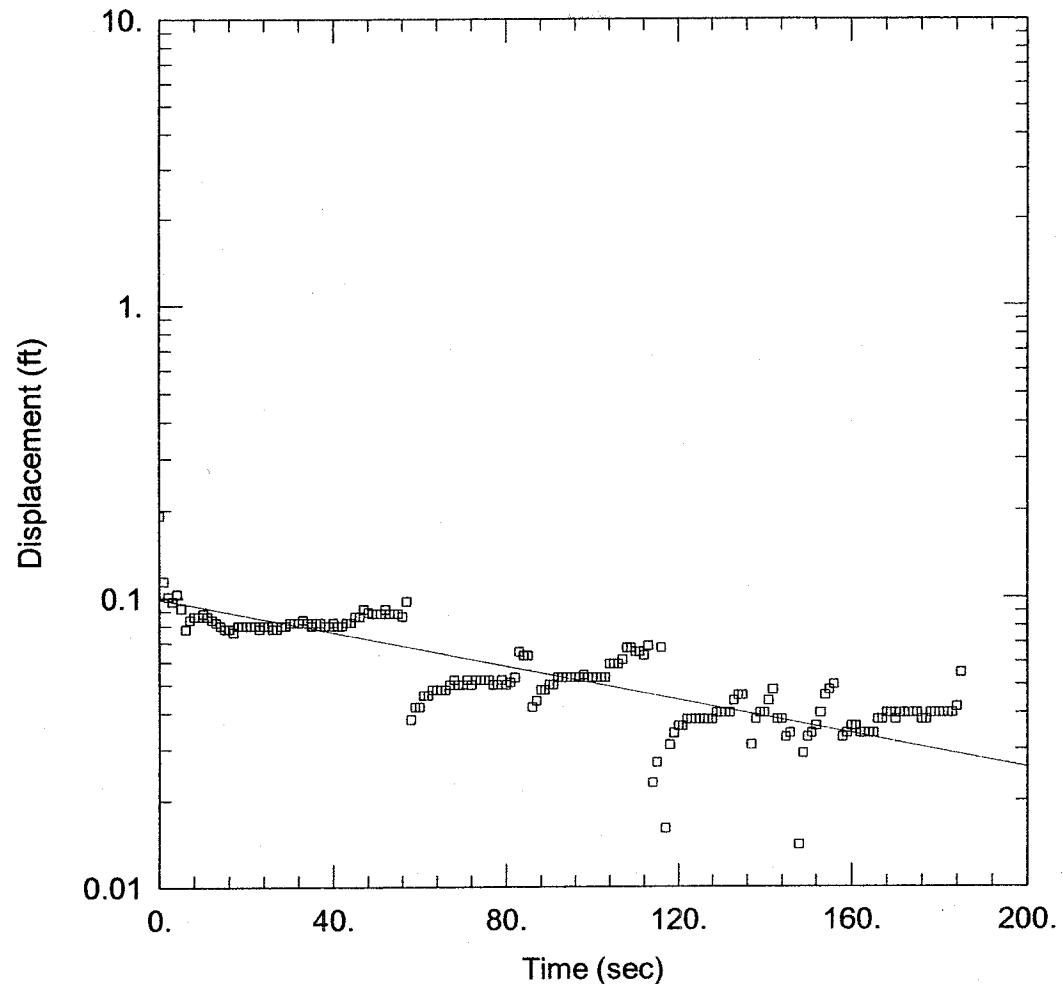
Parameter Correlations

	K	y0
K	1.00	0.78
y0	0.78	1.00

Residual Statistics

for weighted residuals

Sum of Squares ... 0.03464 ft²
Variance..... 0.0001872 ft²
Std. Deviation..... 0.01368 ft
Mean 0.0001282 ft
No. of Residuals ... 187
No. of Estimates ... 2



TEST # 2 BOEING

Data Set: G:\COMMON\SGANDHI\BOEING\BOEING~1\BMW01A.AQT
 Date: 10/17/02 Time: 12:30:47

AQUIFER DATA

Saturated Thickness: 7. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

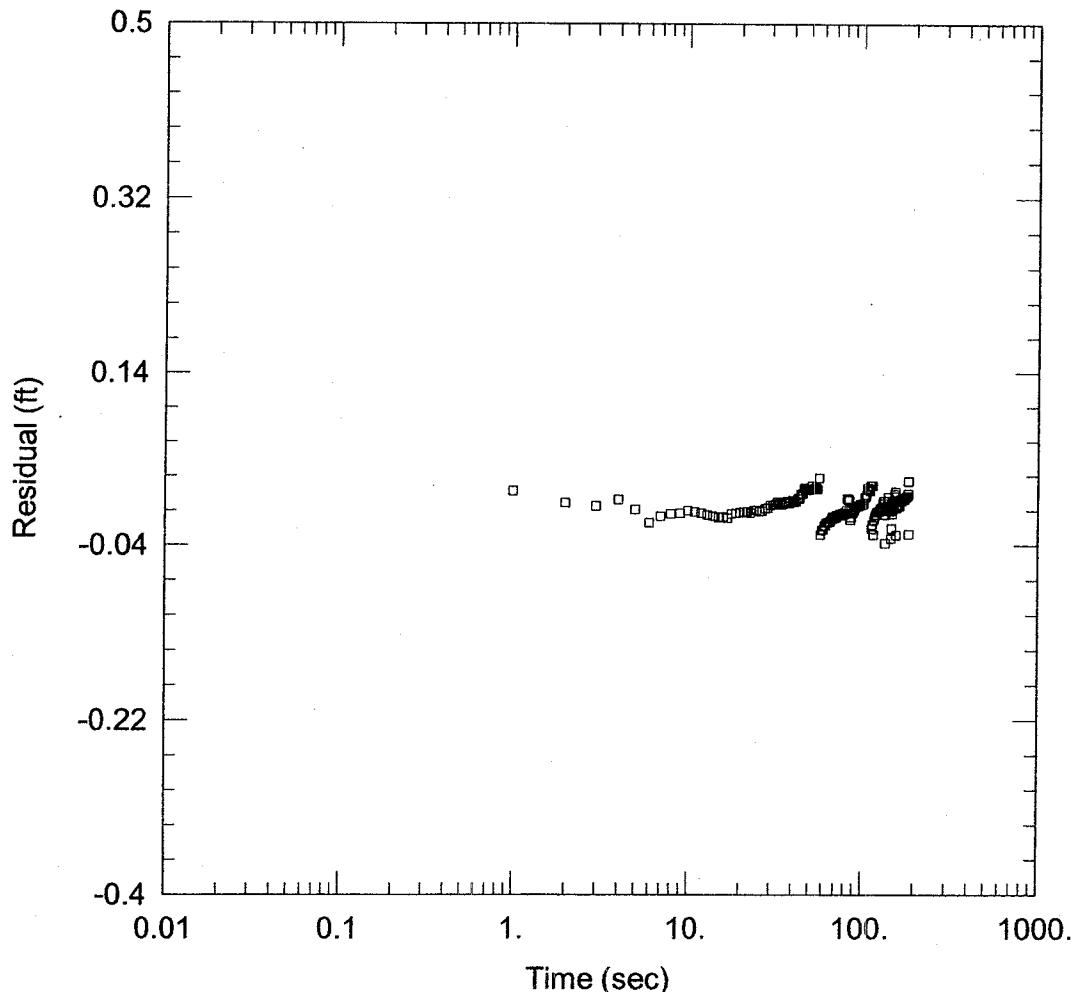
Initial Displacement: 0.192 ft
 Casing Radius: 0.167 ft
 Screen Length: 10. ft

Water Column Height: 7. ft
 Wellbore Radius: 0.833 ft
 Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
 Solution Method: Bouwer-Rice

K = 0.0001203 ft/sec
 y0 = 0.09889 ft



TEST # 2 BOEING

Data Set: G:\COMMON\SGANDHI\BOEING\BOEING~1\BMW01A.AQT
 Date: 10/17/02 Time: 12:30:56

AQUIFER DATA

Saturated Thickness: 7. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 0.192 ft

Water Column Height: 7. ft

Casing Radius: 0.167 ft

Wellbore Radius: 0.833 ft

Screen Length: 10. ft

Gravel Pack Porosity: 0.3

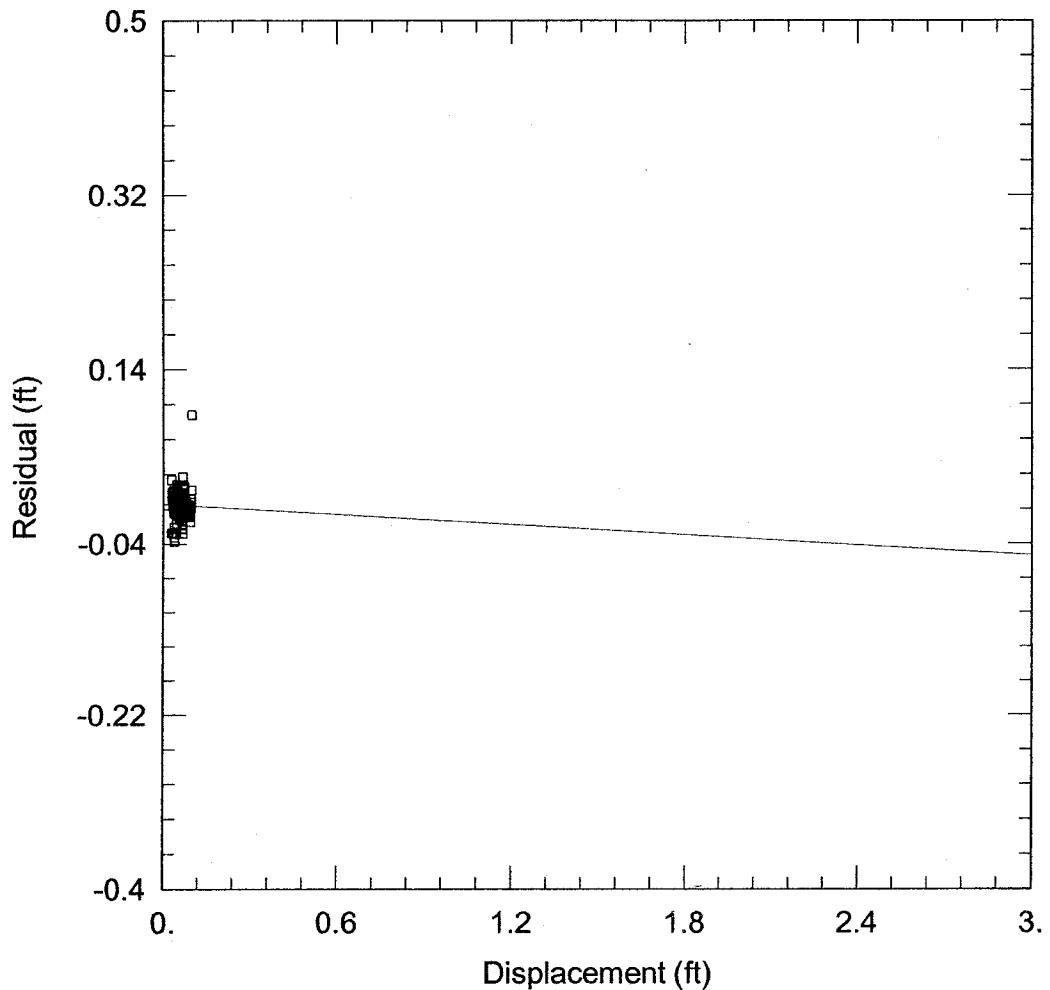
SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

K = 0.0001203 ft/sec

y0 = 0.09889 ft



TEST # 2 BOEING

Data Set: G:\COMMON\SGANDHI\BOEING\BOEING~1\BMW01A.AQT
 Date: 10/17/02 Time: 12:31:02

AQUIFER DATA

Saturated Thickness: 7. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 0.192 ft

Water Column Height: 7. ft

Casing Radius: 0.167 ft

Wellbore Radius: 0.833 ft

Screen Length: 10. ft

Gravel Pack Porosity: 0.3

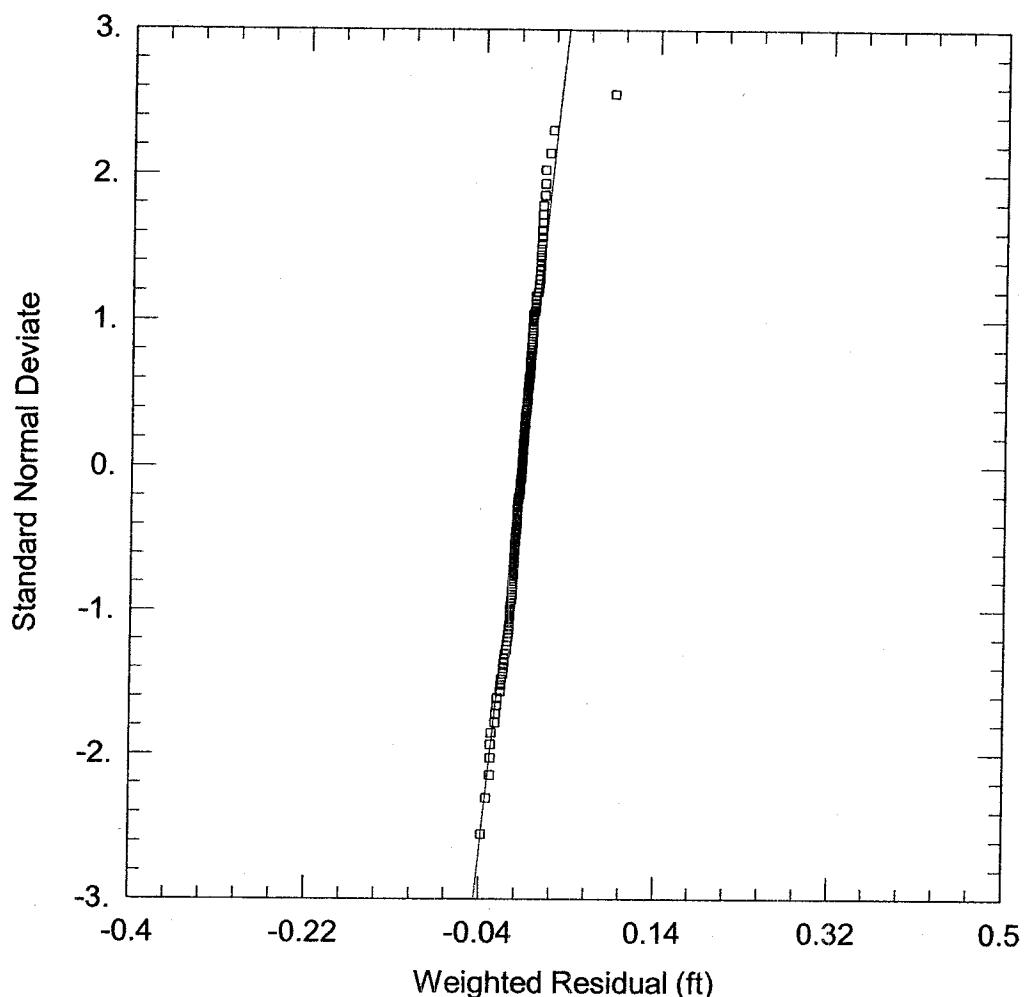
SOLUTION

Aquifer Model: Unconfined

$K = 0.0001203$ ft/sec

Solution Method: Bouwer-Rice

$y_0 = 0.09889$ ft



TEST # 2 BOEING

Data Set: G:\COMMON\SGANDHI\BOEING\BOEING~1\BMW01A.AQT
 Date: 10/17/02 Time: 12:31:06

AQUIFER DATA

Saturated Thickness: 7. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 0.192 ft

Water Column Height: 7. ft

Casing Radius: 0.167 ft

Wellbore Radius: 0.833 ft

Screen Length: 10. ft

Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

K = 0.0001203 ft/sec

y0 = 0.09889 ft

Diagnostic Statistics**Aquifer Model: Unconfined****Solution Method: Bouwer-Rice****Estimated Parameters**

Parameter	Estimate	Std. Error
K	0.0001203	6.439E-06 ft/sec
y0	0.09889	0.002613 ft

Parameter Correlations

	K	y0
K	1.00	0.78
y0	0.78	1.00

Residual Statistics

for weighted residuals

Sum of Squares ... 0.03464 ft²
Variance..... 0.0001872 ft²
Std. Deviation..... 0.01368 ft
Mean 0.0001282 ft
No. of Residuals ... 187
No. of Estimates ... 2

Errors Detected in Data Set

No errors detected!

Options Available

Choose a solution to perform forward solution or curve matching analyses.

Appendix G

Slug Test Analysis (Hvorslev Method) for MW-0001A Using Partial Data Set

Data Set: G:\COMMON\SGANDH\BOEING\BOEING~1\HMW01A.AQT

Title: Test # 2 Boeing

Date: 10/17/02

Time: 12:28:15

AQUIFER DATA

Saturated Thickness: 7 ft

Anisotropy Ratio (Kz/Kr): 1

OBSERVATION WELL DATA

Number of observation wells: 1

Observation Well No. 1: MW0001A

X Location: 0 ft

Y Location: 0 ft

Observation Data

Time (sec)	Displacement (ft)
------------	-------------------

0.	0.192
1.	0.114
2.	0.101
3.	0.097
4.	0.103
5.	0.092
6.	0.078
7.	0.084
8.	0.086
9.	0.086
10.	0.088
11.	0.086
12.	0.084
13.	0.082
14.	0.08
15.	0.078
16.	0.078
17.	0.076
18.	0.08
19.	0.08
20.	0.08
21.	0.08
22.	0.08
23.	0.078
24.	0.08
25.	0.08
26.	0.078
27.	0.078
28.	0.08
29.	0.08
30.	0.082

31.	0.082
32.	0.082
33.	0.084
34.	0.082
35.	0.08
36.	0.082
37.	0.082
38.	0.08
39.	0.08
40.	0.082
41.	0.08
42.	0.08
43.	0.082
44.	0.082
45.	0.086
46.	0.086
47.	0.091
48.	0.089
49.	0.088
50.	0.088
51.	0.088
52.	0.091
53.	0.088
54.	0.088
55.	0.088
56.	0.086
57.	0.097
58.	0.038
59.	0.042
60.	0.042
61.	0.046
62.	0.046
63.	0.048
64.	0.048
65.	0.048
66.	0.048
67.	0.05
68.	0.052
69.	0.05
70.	0.05
71.	0.052
72.	0.05
73.	0.052
74.	0.052
75.	0.052
76.	0.052
77.	0.05
78.	0.05
79.	0.052
80.	0.05
81.	0.051
82.	0.053

83.	0.065
84.	0.063
85.	0.063
86.	0.042
87.	0.044
88.	0.048
89.	0.048
90.	0.05
91.	0.05
92.	0.053
93.	0.053
94.	0.053
95.	0.053
96.	0.053
97.	0.053
98.	0.054
99.	0.053
100.	0.053
101.	0.053
102.	0.053
103.	0.053
104.	0.059
105.	0.059
106.	0.059
107.	0.061
108.	0.067
109.	0.067
110.	0.065
111.	0.065
112.	0.063
113.	0.068
114.	0.023
115.	0.027
116.	0.067
117.	0.016
118.	0.031
119.	0.034
120.	0.036
121.	0.036
122.	0.038
123.	0.038
124.	0.038
125.	0.038
126.	0.038
127.	0.038
128.	0.038
129.	0.04
130.	0.04
131.	0.04
132.	0.04
133.	0.044
134.	0.046

135.	0.046
136.	0.002
137.	0.031
138.	0.038
139.	0.04
140.	0.04
141.	0.044
142.	0.048
143.	0.038
144.	0.038
145.	0.033
146.	0.034
147.	0.004
148.	0.014
149.	0.029
150.	0.033
151.	0.034
152.	0.036
153.	0.04
154.	0.046
155.	0.048
156.	0.05
157.	0.005
158.	0.033
159.	0.034
160.	0.036
161.	0.036
162.	0.034
163.	0.034
164.	0.034
165.	0.034
166.	0.038
167.	0.038
168.	0.04
169.	0.04
170.	0.038
171.	0.04
172.	0.04
173.	0.04
174.	0.04
175.	0.04
176.	0.038
177.	0.038
178.	0.04
179.	0.04
180.	0.04
181.	0.04
182.	0.04
183.	0.04
184.	0.042
185.	0.055
186.	0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

VISUAL ESTIMATION RESULTS**Estimated Parameters**

Parameter	Estimate
K	0.0001203 ft/sec
y0	0.09889 ft

AUTOMATIC ESTIMATION RESULTS**Estimated Parameters**

Parameter	Estimate	Std. Error
K	0.0001894	1.014E-05 ft/sec
y0	0.09889	0.002612 ft

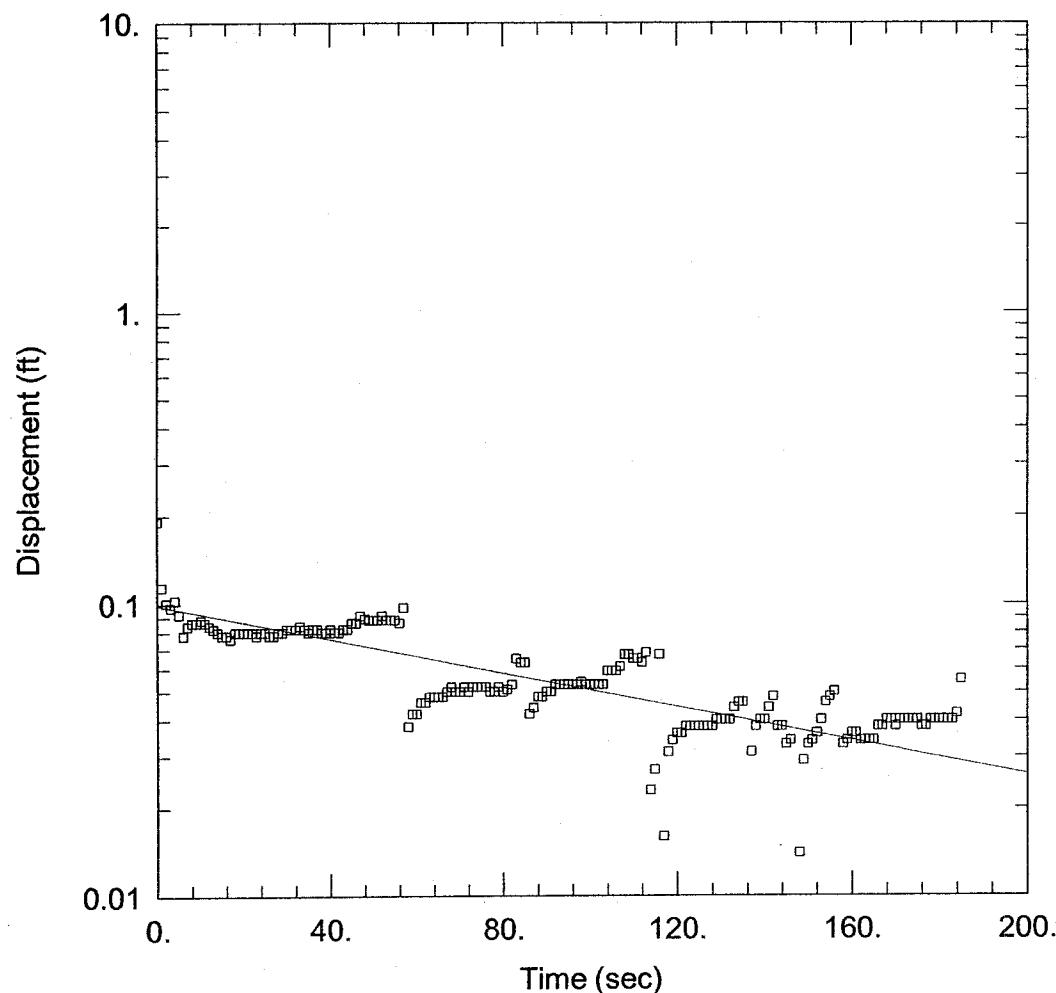
Parameter Correlations

	K	y0
K	1.00	0.78
y0	0.78	1.00

Residual Statistics

for weighted residuals

Sum of Squares ... 0.03464 ft²
Variance..... 0.0001872 ft²
Std. Deviation..... 0.01368 ft
Mean 0.0001277 ft
No. of Residuals ... 187
No. of Estimates ... 2



TEST # 2 BOEING

Data Set: G:\COMMON\SGANDHI\BOEING\BOEING~1\HMW01A.AQT
 Date: 10/17/02 Time: 12:28:33

AQUIFER DATA

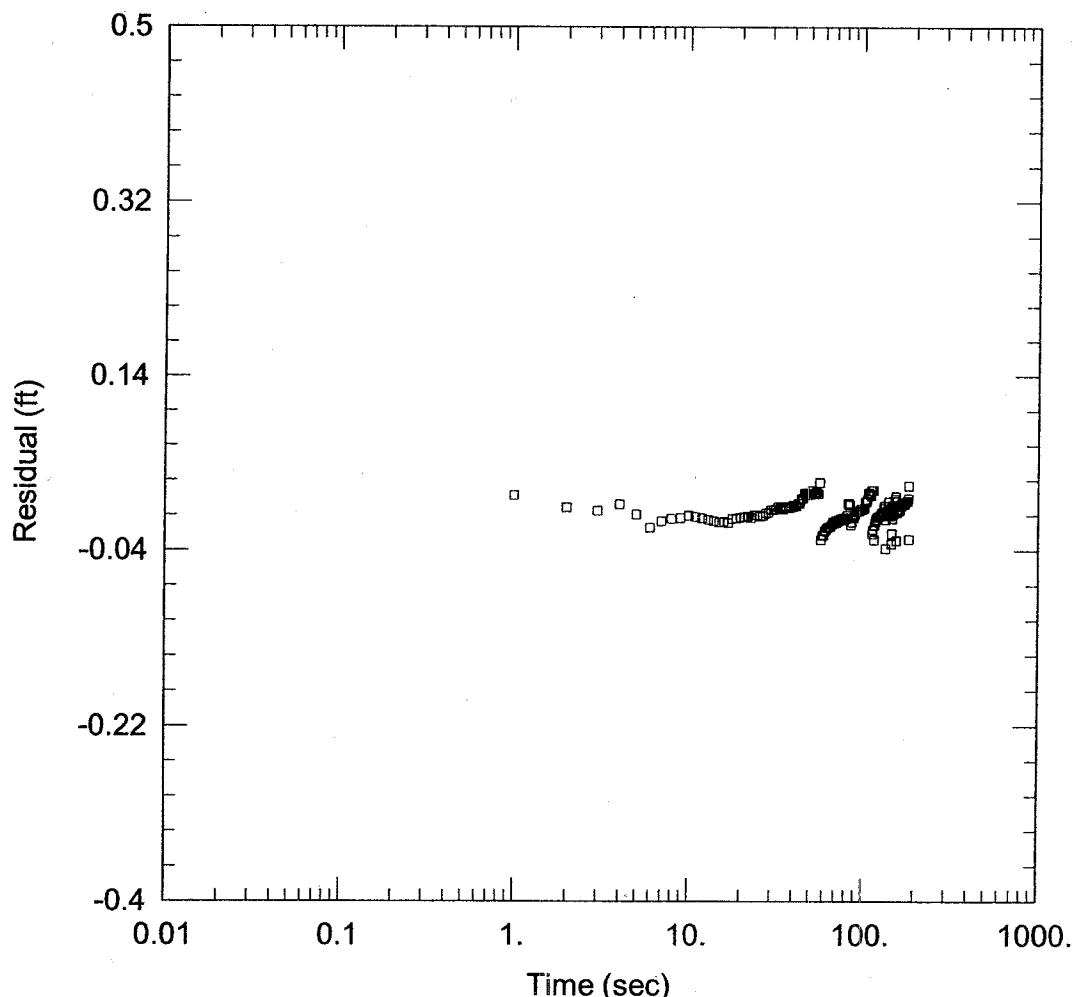
Saturated Thickness: 7. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 0.192 ft Water Column Height: 7. ft
 Casing Radius: 0.167 ft Wellbore Radius: 0.833 ft
 Screen Length: 10. ft Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined $K = 0.0001894$ ft/sec
 Solution Method: Hvorslev $y_0 = 0.09889$ ft



TEST # 2 BOEING

Data Set: G:\COMMON\GANDHI\BOEING\BOEING~1\HMW01A.AQT
 Date: 10/17/02 Time: 12:28:38

AQUIFER DATA

Saturated Thickness: 7. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 0.192 ft

Water Column Height: 7. ft

Casing Radius: 0.167 ft

Wellbore Radius: 0.833 ft

Screen Length: 10. ft

Gravel Pack Porosity: 0.3

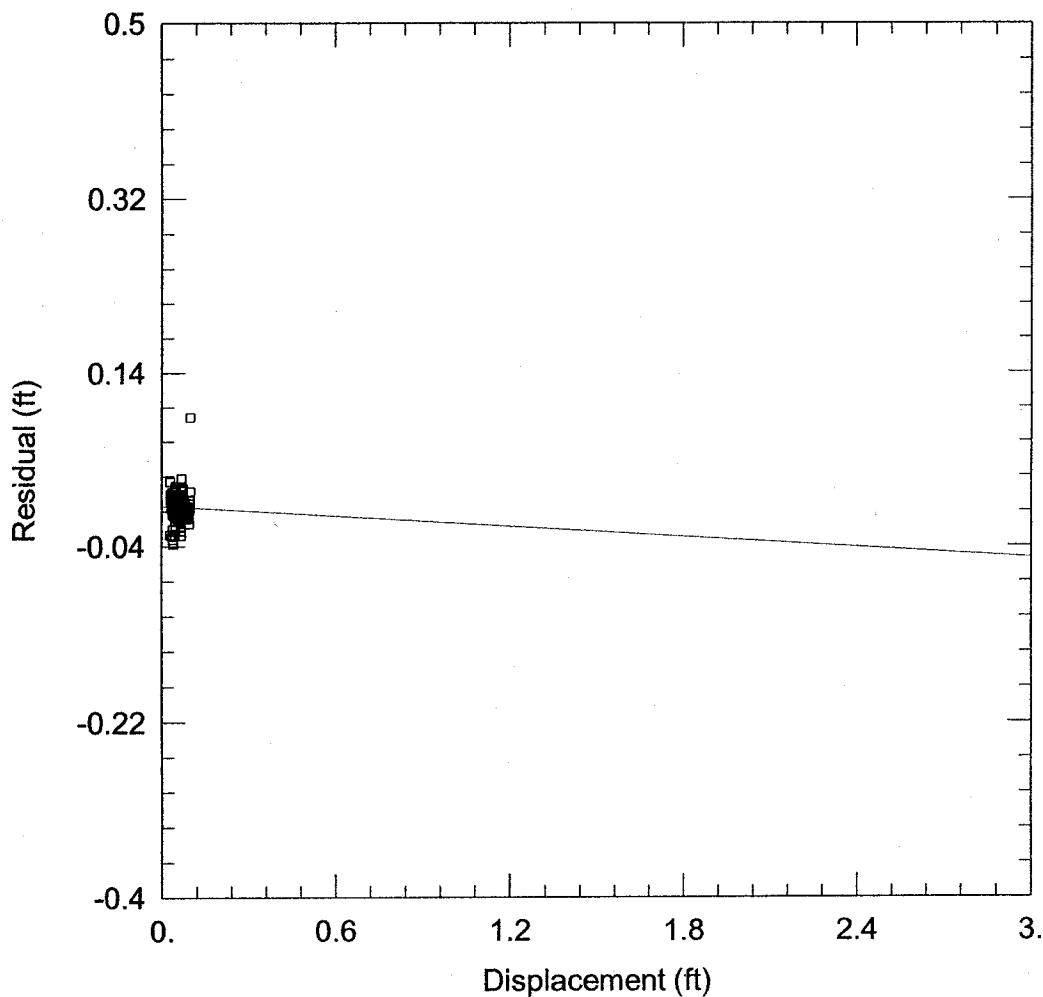
SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

K = 0.0001894 ft/sec

y0 = 0.09889 ft



TEST # 2 BOEING

Data Set: G:\COMMON\SGANDHI\BOEING\BOEING~1\HMW01A.AQT
 Date: 10/17/02 Time: 12:28:45

AQUIFER DATA

Saturated Thickness: 7. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 0.192 ft

Water Column Height: 7. ft

Casing Radius: 0.167 ft

Wellbore Radius: 0.833 ft

Screen Length: 10. ft

Gravel Pack Porosity: 0.3

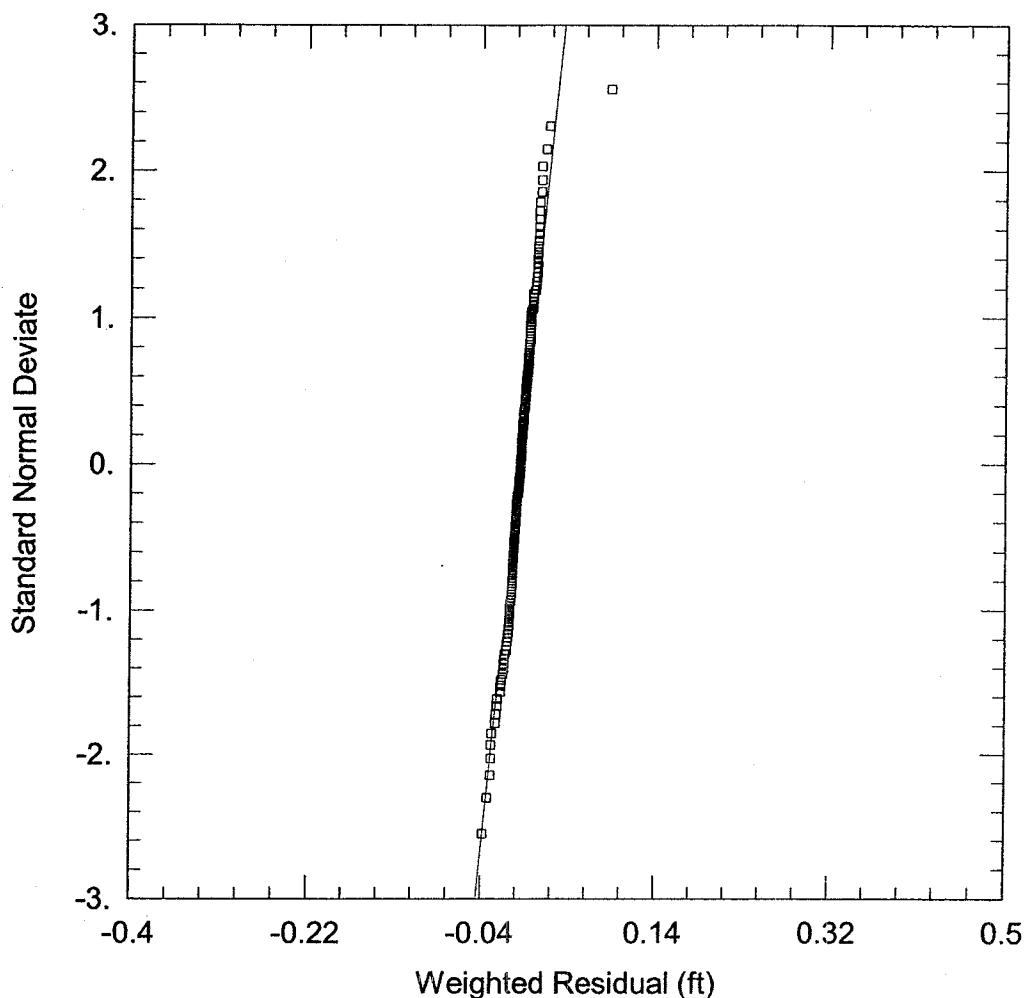
SOLUTION

Aquifer Model: Unconfined

K = 0.0001894 ft/sec

Solution Method: Hvorslev

y0 = 0.09889 ft



TEST # 2 BOEING

Data Set: G:\COMMON\SGANDHI\BOEING\BOEING~1\HMW01A.AQT
 Date: 10/17/02 Time: 12:28:52

AQUIFER DATA

Saturated Thickness: 7. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 0.192 ft

Water Column Height: 7. ft

Casing Radius: 0.167 ft

Wellbore Radius: 0.833 ft

Screen Length: 10. ft

Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

$K = 0.0001894 \text{ ft/sec}$

$y_0 = 0.09889 \text{ ft}$

Diagnostic Statistics

Aquifer Model: Unconfined
Solution Method: Hvorslev

Estimated Parameters

Parameter	Estimate	Std. Error
K	0.0001894	1.014E-05 ft/sec
y0	0.09889	0.002612 ft

Parameter Correlations

	K	y0
K	1.00	0.78
y0	0.78	1.00

Residual Statistics

for weighted residuals

Sum of Squares ... 0.03464 ft²
Variance..... 0.0001872 ft²
Std. Deviation..... 0.01368 ft
Mean 0.0001277 ft
No. of Residuals ... 187
No. of Estimates ... 2

Errors Detected in Data Set

No errors detected!

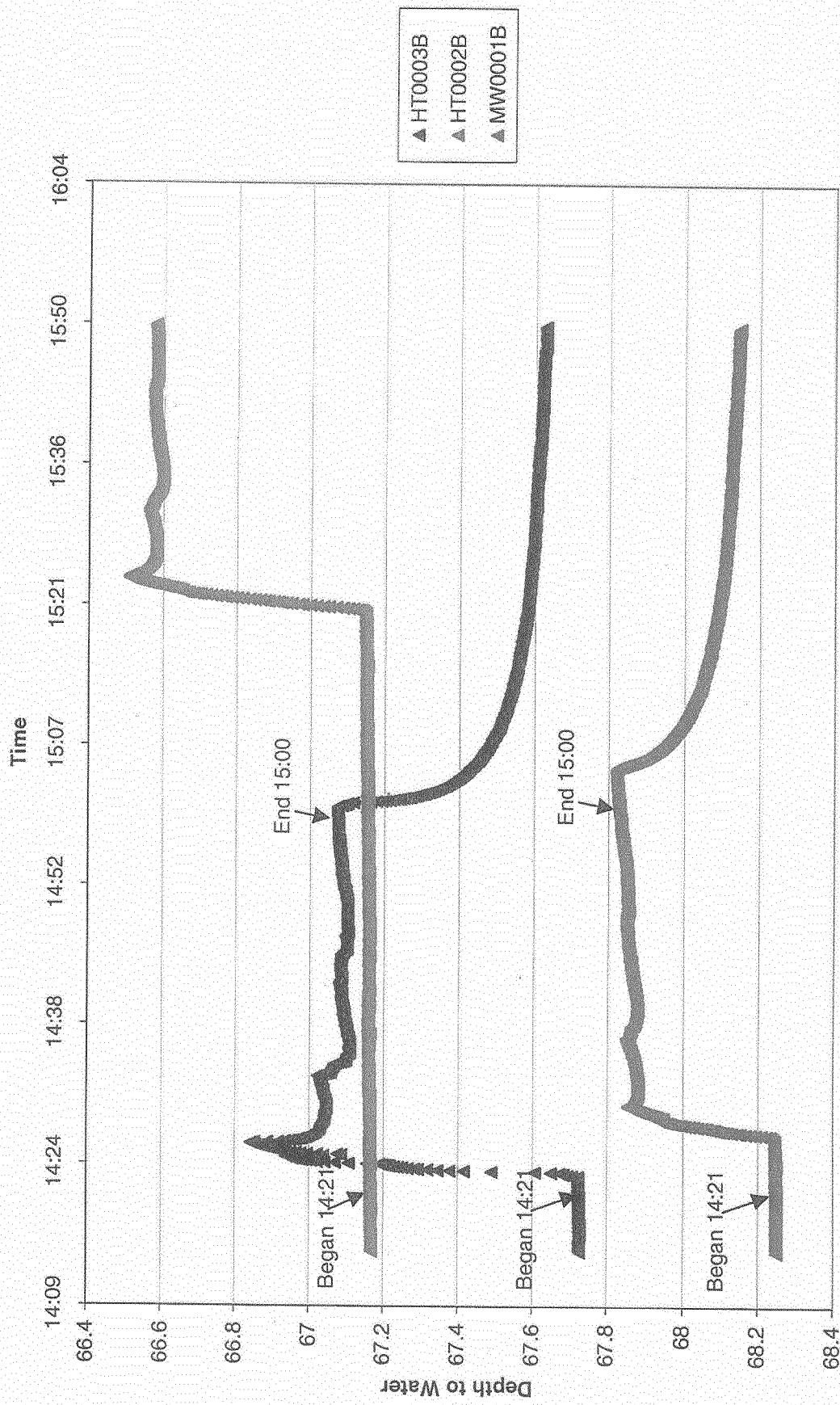
Options Available

Choose a solution to perform forward solution or curve matching analyses.

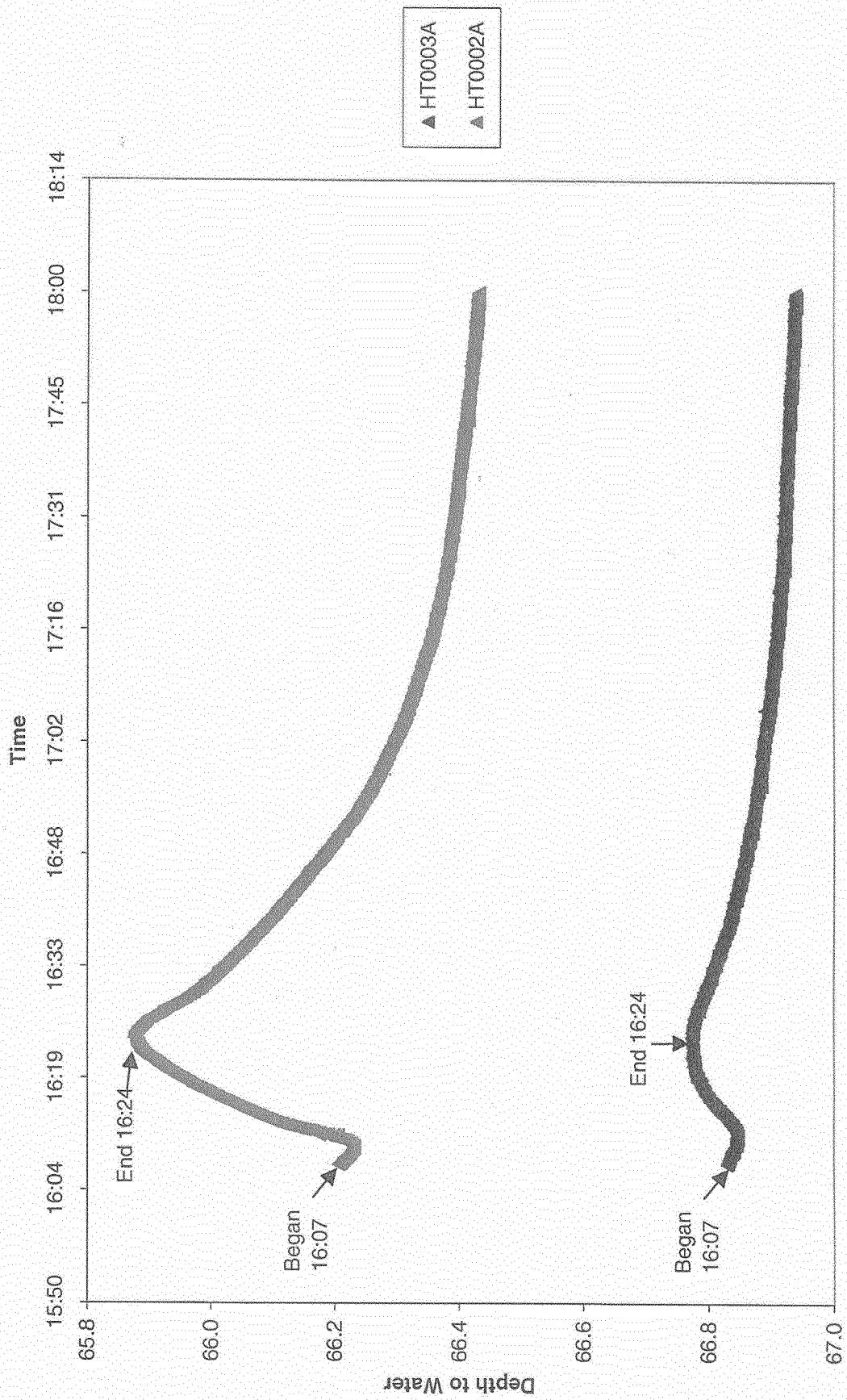
Appendix H

Change in Groundwater Elevation During Injection Activities

Data Plot in from HT-0001B injection



Data Plot from HT-0001A Injection



Data Plot from MW-0001A Injection

